

Region of Waterloo 2018 Wastewater Treatment Master Plan

July 2018



This report contains technical information. Alternate formats of this document are available upon request. Please contact Nicole Sapeta at nsapeta@regionofwaterloo.ca, 519-575-4400 ext. 3682, TTY: 519-575-4608 to request an alternate format.

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List of Acronyms

ACS	Assimilative Capacity Study
ADF	Average Daily Flow
BMF	Biosolids Management Facility
BMP	Biosolids Master Plan
BNR	Biological Nutrient Removal
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CEPT	Chemically Enhanced Primary Treatment
CofA	Certificate of Approval
CWQGs	Canadian Water Quality Guidelines
CHP	Combined Heat and Power
COD	Chemical Oxygen Demand
CORMIX	Cornell Mixing Zone Expert System
DO	Dissolved Oxygen
EA	Environmental Assessment
ECA	Environmental Compliance Approval
ESL	East Side Lands
ESR	Environmental Study Report
FOG	Fats, oil, and grease
GGH	Greater Golden Horseshoe
GHG	Greenhouse Gas
GLWQA	Great Lakes Water Quality Agreement
GRCA	Grand River Conservation Authority

GRSM	Grand River Simulation Model
HRT	Hydraulic Retention Time
I/I	Inflow and Infiltration
ICI	Industrial, Commercial and Institutional
IRSA	Industrial Road Service Area
LCC	Life Cycle Cost
MABR	Membrane Aerated Biofilm Reactor
MBR	Membrane Bioreactor
MEA	Municipal Engineers Association
MLD	Megaliters per day
MLSS	Mixed Liquor Suspended Solids
MOECC	Ontario Ministry of the Environment and Climate Change
NH ₃ -N	Ammonia
NOD	Nitrogenous Oxygen Demand
NPV	Net Present Value
O&M	Operation and Maintenance
OCWA	Ontario Clean Water Agency
OWRA	Ontario Water Resources Act
P2G	Places to Grow
P2GA2	Places to Grow Amendment 2
PAD	Post Aerobic Digestion
PCC	Public Consultation Centre
PDF	Peak Day Flow
PHF	Peak Hourly Flow
PIF	Peak Instantaneous Flow
PPG	Performance Potential Graph

PTAC	Planning and Technical Advisory Committee
PWQMN	Provincial Water Quality Monitoring Network
PWQO	Provincial Water Quality Objective
PWWF	Peak Wet Weather Flow
RAS	Return Activated Sludge
RBCs	Rotating Biological Contactors
RGMS	Regional Growth Management Strategy
RMOW	Region Municipality of Waterloo
RNG	Renewable Natural Gas
ROP	Regional Official Plan
RWQIS	Receiving Water Quality Impact Study
SBRs	Sequencing Batch Reactors
SC	Steering Committee
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
SPS	Sewage Pumping Station
SRT	Solids Retention Time
SSO	Source Separated Organics
SWQMP	Surface Water Quality Monitoring Program
TAN	Total Ammonia-Nitrogen
THP	Thermal Hydrolysis Process
TKN	Total Kjeldahl Nitrogen
TM	Technical Memorandum
TN	Total Nitrogen
TP	Total Phosphorus
TPAD	Temperature Phased Anaerobic Digestion

TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
UIA	Un-ionized Ammonia
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UW	University of Waterloo
VFA	Volatile Fatty Acids
VS	Volatile Solids
VSR	Volatile Solids Reduction
WAS	Waste Activated Sludge
WEF	Water Environmental Federation
WMP	Water Management Plan
WWTMP	Wastewater Treatment Master Plan
WWTP	Wastewater Treatment Plant
WWWMR	Water and Wastewater Monitoring Reports

ES-1. Introduction

ES-1.1 Background

The Regional Municipality of Waterloo (Region) completed a Wastewater Treatment Master Plan (WWTMP) in 2007 that provided strategic long-term planning for the Region's wastewater treatment services and recommended preferred alternatives to meet growth needs to the year 2041. In light of recent trends in wastewater flows and population growth, regulatory requirements, and climate patterns, the Region has initiated this study to update the WWTMP. The goal of this study (the 2018 WWTMP Update) was to develop a current, comprehensive, cost-effective and feasible strategy to address the anticipated wastewater treatment needs of the Region over the next 35 years that is consistent with the Region's 2015-2018 Strategic Plan.

The 2018 WWTMP Update was completed under the Environmental Assessment Act in accordance with Municipal Class Environmental Assessment (EA) requirements, and provides an overall plan for the upgrade and/or expansion of the Region's wastewater facilities until the year 2051. Recommendations have been developed to accommodate future population growth, meet level of treatment needs, enhance operations and reduce energy use. In addition to facility-specific recommendations, recommendations benefitting all Regional wastewater facilities were also identified. An implementation plan was also developed to identify the recommended timing and financial impacts for the master plan growth and treatment recommendations.

ES-1.2 Service and Study Areas

The Region owns thirteen (13) Wastewater Treatment Plants (WWTPs) that have been reviewed as part of this WWTMP Update over the 35-year planning period, including Kitchener, Waterloo, Galt, Preston, Hespeler, Elmira, New Hamburg, Ayr, St. Jacobs, Wellesley, Alt-Heidelberg, Foxboro Green and Foxboro Green WWTPs. These wastewater facilities are operated and maintained by the Ontario Clean Water Agency (OCWA), under contract to the Region.

The Region also owns seven (7) Sewage Pumping Stations (SPSs) including Spring Valley, Bridgeport, Baden, Morningside, Rose Street, Ayr and Nith River Way SPSs. Figure ES-1 shows the location and the service areas of key wastewater infrastructure in the Region.

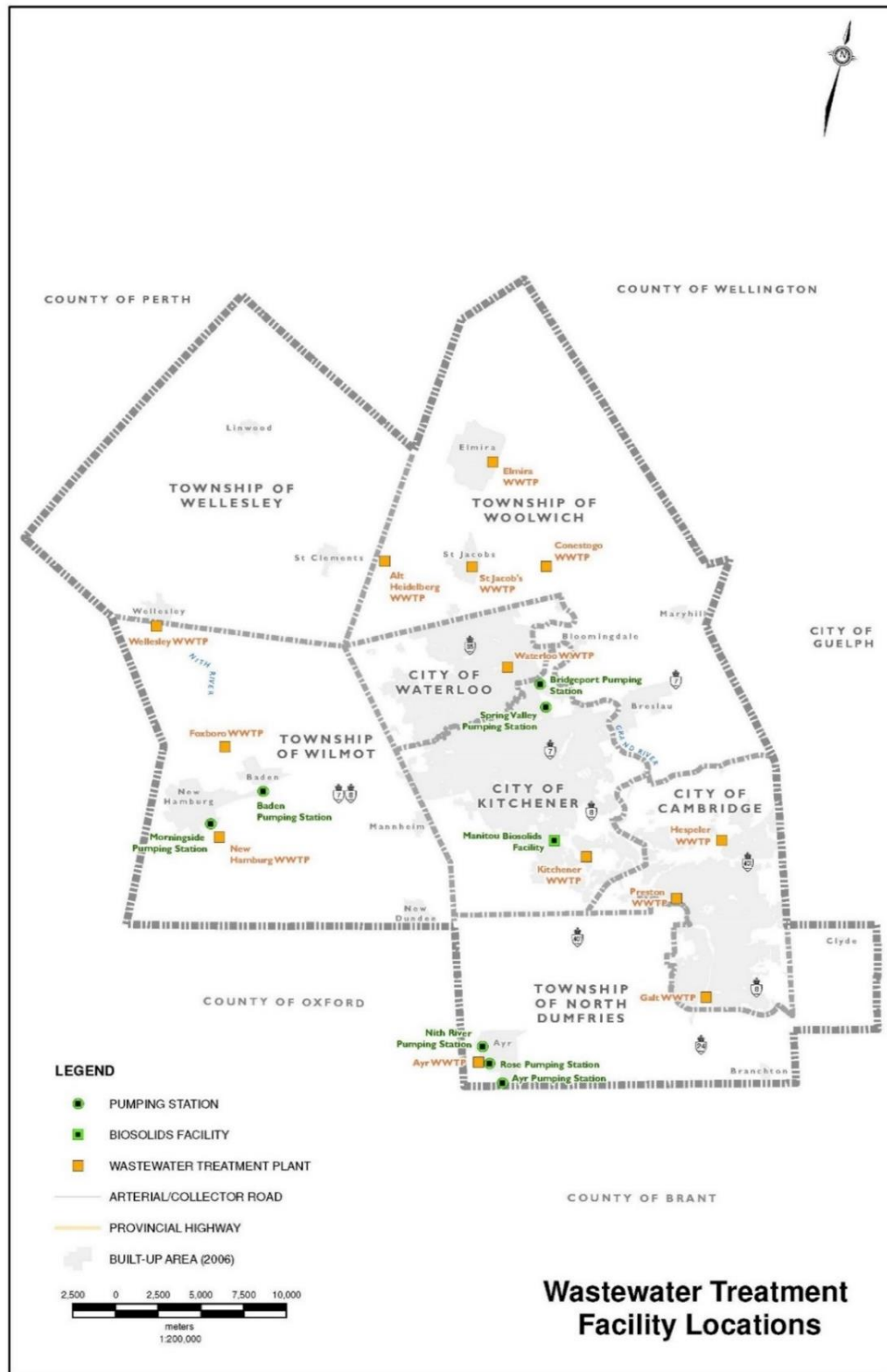


Figure ES-1 Region of Waterloo Wastewater Infrastructure Service Areas

ES-1.3 Class Environmental Assessment Process

The 2018 WWTMP Update was undertaken under the Environmental Assessment Act in accordance with Municipal Class EA requirements (2000, as amended in 2007, 2011 and 2015).

The Master Plan provisions of the Municipal Class EA allow municipalities to develop long range plans for integrated infrastructure requirements. The 2018 WWTMP Update represents Phases 1 and 2 of the Class EA process.

ES-2. Population and Flow Projections

The population projections within the Region form the basis of establishing projected wastewater flows and ultimately future servicing plans. Population projections were established based on the moderate growth scenario developed by the Region's Planning Department for the 35-year (2016 to 2051) planning horizon along with corresponding projected wastewater flows. Figure ES-2 shows the moderate growth scenario used for the 2018 WWTMP Update, along with the population projections used in the 2007 WWTMP, and the recently revised Places to Grow Amendment 2 (P2GA2) population projections for comparison.

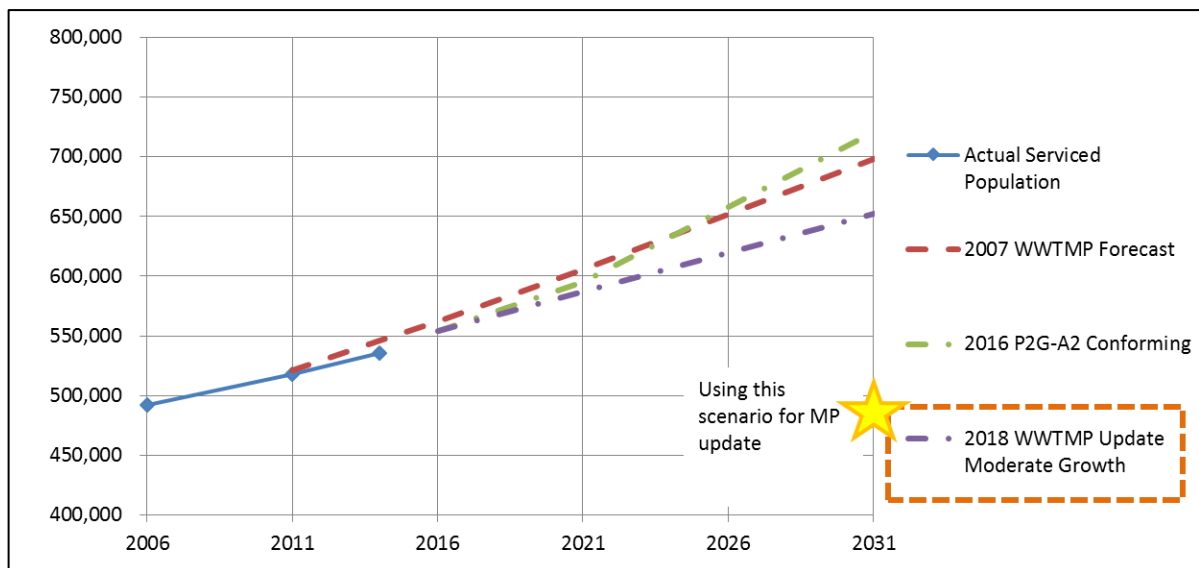


Figure ES-2 Service Population Projections for the Region of Waterloo

Prediction for wastewater flows is one of the most important components of wastewater master planning. The flow projections to 2051 for each individual WWTP and SPS service area are shown in Table ES-1 and Table ES-2, respectively. As the flow rates approach 85% of the WWTP/SPS capacity, the planning process for expansion should be triggered (i.e. Class EA) (MOECC, 1995).

Table ES-1 2051 Wastewater Flow Projections to WWTPs

Service Area	Average Day Flow (m³/day)		Rated Capacity (m³/day)	Year to Reach 85% Rated Capacity	Year to Reach 100% Rated Capacity
	2016	2051			
Kitchener ⁽¹⁾	71,840	103,150	122,745	>2051	>2051
Waterloo	46,600	60,530	57,500	2020	2041
Galt	36,150	49,010	56,800	2048	>2051
Preston ⁽¹⁾	9,500	11,890	16,860	>2051	>2051
Hespeler	7,080	9,900	9,320	2036	2047
Ayr	1,430	2,760	3,000	2043	>2051
New Hamburg	4,260	6,870	6,900	2041	2051
Wellesley	820	1,260	1,100	2032	2041
St. Jacobs	990	1,530	1,450	2025	2042
Elmira	4,480	9,460	7,800	2030	2039
East Side Lands	360	8,270	-	-	-
Unserviced Areas	8,680	12,160	-	-	-

Notes:

1. Flows do not include East Side Lands.

Table ES-2 2051 Projected Flows to Sewage Pumping Stations

SPS	Peak Wet Weather Flow (L/s)		Firm Capacity (L/s)	Year to Reach 85% Firm Capacity	Year to Reach 100% Firm Capacity
	2016	2051			
Bridgeport	85	115	136	>2051	>2051
Spring Valley	210	250	245	2017	2045
Baden	185	225	187	<2016	2021
Morningside	205	270	248	2019	2041
Rose Street	40	50	80	>2051	>2051
Ayr ⁽¹⁾	N/A	40	46	2048	>2051
Nith River Way	N/A – Dedicated Development Sewage Pumping Station, No Projected Growth.		3.9	No Projected Growth	

Notes:

1. Ayr SPS is currently under construction, with a firm capacity of 46 L/s for Phase 1 and 84 L/s for Phase 2. There is no existing population data available in 2016.

ES-3. Receiving Water Assessment

As part of this Master Plan update, alternatives have been identified to accommodate growth and meet level of treatment requirements. In support of the evaluation of alternatives, anticipated future effluent objectives were identified for each of the WWTPs, based on the review of previously completed Assimilative Capacity Studies (ACSs), recent water quality data from the Surface Water Quality Monitoring Program (SWQMP), and other available studies related to the receiving waters.

A summary of suggested effluent objectives and anticipated level of treatment is provided in Table ES-3. It should be noted that only treatment objectives where a change is expected is summarized in this table.

Table ES-3 Suggested Effluent Objectives and Anticipated Level of Treatment

WWTP	Future CBOD ₅ Objective (mg/L)	Future TSS Objective (mg/L)	Future Ammonia-N Objective (mg/L)	<i>E. coli</i> (cfu/100 mL)	Suggested Future TP Treatment Objectives		Required Level of Treatment
					Conc. (mg/L)	Loading (kg/d)	
Waterloo	No Change from Existing	No Change from Existing	No Change from Existing	No Change from Existing	0.23	14.6	Tertiary filtration
Preston	No Change from Existing	No Change from Existing	No Change from Existing	No Change from Existing	0.40	6.7	Secondary treatment with chemical phosphorus removal
Hespeler	10	10	2 (non-freezing) ⁽¹⁾ 5 (freezing) ⁽²⁾	No Change from Existing	0.40	4.2	Secondary treatment with chemical phosphorus removal
Wellesley	5	5	0.35	100	0.42	0.55	Tertiary filtration
St Jacobs	No Change from Existing	No Change from Existing	0.5 (non-freezing) ⁽¹⁾ 1.0 (freezing) ⁽²⁾	No Change from Existing	0.18	0.30	Tertiary filtration
Elmira	No Change from Existing	No Change from Existing	No Change from Existing	100	0.15	1.56	Tertiary filtration

Notes:

1. Non-freezing: May 1 to October 31.
2. Freezing: November 1 to September 30.
3. Galt WWTP will require an update to the ECA based on anticipated Lake Erie targets; however, no upgrades are required to meet the required level of treatment (tertiary filters already installed).
4. No changes to level of treatment are expected for the Kitchener, Ayr, New Hamburg, Conestogo, Foxboro, Alt-Heidelberg WWTPs as expansions are not required within the planning horizon, and upgrades are not expected based on anticipated Lake Erie targets (i.e. plants are either already achieving anticipated Lake Erie targets or the average day rated capacity is less than 3,780 m³/d).

ES-4. Problem and Opportunity Statement

Growth and level of treatment needs were identified based on the review of the existing conditions, historical performance, and capacity review of major unit processes for each WWTP.

Growth

To accommodate the need for growth, expansions are recommended for the following WWTPs:

- + Waterloo, Elmira, and St Jacobs WWTP before 2030
- + Hespeler and Wellesley before 2040

In addition, Regional SPSs identified for expansion include:

- + Spring Valley, Morningside, and Baden WWPS before 2030

Level of Treatment

In addition to the receiving water limitations, the Canada-Ontario Draft Action Plan for Lake Erie (Draft Action Plan), which is expected to be finalized in 2018, proposes a new legal effluent discharge limit of 0.5 mg/L total phosphorus (TP) for all municipal WWTPs with an average daily flow of 3,780 m³/d or greater.

The following plants are expected to have effluent quality requirement changes based on expansion to accommodate growth and/or the Lake Erie targets:

- + Waterloo (expansion and Lake Erie targets)
- + Preston (Lake Erie targets)
- + Hespeler (expansion and Lake Erie targets)
- + Wellesley (expansion)
- + St Jacobs (expansion)
- + Elmira (expansion)

ES-5. East Side Lands Servicing

The East Side Lands (ESL) refer to the developable area on the east side of the Grand River, surrounding the Waterloo Regional Airport. The area encompasses approximately 4,000 hectares of land in the Township of Woolwich, the City of Cambridge, and the City of Kitchener. It is anticipated to be predominately a mixture of industrial, commercial and institutional (ICI) with some residential land use.

Several planning studies have provided input on sanitary servicing for the ESLs and the following are recommended:

- ✦ Service the south area of the ESL in the short-term using the available capacity at the Preston WWTP (Earth Tech, 2007)
- ✦ Construct a gravity trunk sewer with a dedicated service bridge over the Grand River to divert flows from the southern area of the ESL to the Kitchener WWTP (Associate Engineering, ongoing)

As part of the Master Plan update, a review was completed to estimate when the long-term servicing solution will need to be constructed. The trigger for implementing the long-term solution was also reviewed based on available capacity at the Preston WWTP and the Fountain St trunk.

Available capacities indicate the Preston WWTP average day rated capacity would be exceeded before a constraint would occur in the Fountain St trunk. Based on current growth projections, Preston WWTP has sufficient capacity to manage projected flows until approximately 2041. The construction of the long-term solution to convey flows to the Kitchener WWTP is to be phased to ensure the Preston WWTP continues to operate within the approved rated capacity. After this long-term servicing solution has been constructed, capacity in the Fountain St trunk and at the Preston WWTP will be restored.

ES-6. Preferred Alternatives

ES-6.1 Alternatives Development

As part of the 2018 WWTMP Update, options were developed to accommodate growth, meet level of treatment needs, and enhance operations and reduce energy. Plant-specific options were identified, as well as options that would benefit all Regional facilities. In order to develop a robust long-term servicing plan for the

Region's wastewater treatment plants and pumping stations, both infrastructure options and non-infrastructure opportunities were identified for facilities. Infrastructure options are approaches that are more widely accepted by the industry and there is a high level of confidence that approvals could be obtained (such as expansions to existing processes or installing new technologies). Non-infrastructure options represent new approaches and will require additional studies and consultation to confirm feasibility and approvals. In general, non-infrastructure opportunities focus on changes to operations or implementing new programs to achieve objectives.

A preliminary screening was completed to identify a short list of alternatives to be further developed and evaluated.

ES-6.2 Alternatives Evaluation

The short-listed alternatives were evaluated based on a set of evaluation categories, criteria and weightings as related to the environmental, social, financial and technical factors, to identify preferred alternatives to address the needs of wastewater systems and the developable areas (i.e., ESL) within the Region.

ES-6.3 Preferred Alternatives

ES-6.3.1 Regional Wastewater Recommendations

The Regional wastewater recommendations include:

- + Decrease Inflow/Infiltration – continue to work with area municipalities to reduce inflow and infiltration flows being conveyed to treatment and pumping facilities;
- + Watershed Management – continue to collaborate with key stakeholders, such as the Grand River Conservation Authority (GRCA), on the GRCA Watershed Water Management Plan;
- + Water Re-use – investigate opportunities and benefits of water re-use in greenfield developments.
- + Resource Recovery – evaluate opportunities to recover nutrients such as nitrogen and phosphorus from the wastewater treatment process for beneficial end- use with new emerging technologies;

- + Industrial Pre-treatment – look for opportunities to reduce industrial loadings through Sewer Use By-Laws and promoting pre-treatment at the sources of discharge;
- + Asset/Energy Management – continue to look for opportunities to reduce energy consumption, greenhouse gas emissions, and energy costs;
- + Surface Water Quality Monitoring Program – continue with the program for supporting upgrade and expansion of wastewater treatment facilities, and to better understand the long-term impact of these facilities and non-point sources on the receiving streams and rivers.

ES-6.3.2 Plant-specific Growth and Level of Treatment Improvements

A summary of the plant-specific growth and level of treatment recommendations is shown in Table ES-4. Alternatives identified as infrastructure options include expansion using both conventional and new technology (such as membrane aerated biofilm reactor (MABR) or granular sludge). Also included are non-infrastructure approaches designed to maximize the use of existing infrastructure, including re-rating and phosphorus off-setting. To ensure that the Region has a fully-funded plan in place following the completion of this WWTMP Update, for each plant, for both growth and level of treatment, an infrastructure option has been selected as the preferred alternative, and non-infrastructure opportunities are noted where available for future investigation.

Table ES-4 Summary of Growth and Level of Treatment Recommendations

WWTP	Growth Recommendations		Level of Treatment Recommendations	
	Infrastructure Option	Non-Infrastructure Opportunity	Infrastructure Option	Non-Infrastructure Opportunity
Kitchener	• None required		• None required	
Waterloo	• Expansion with new technology (granular sludge or similar)	• Expansion by re-rating	• Phosphorus removal (new tertiary filters) at Waterloo WWTP	None
Galt	• None required		• Can achieve Lake Erie Basin limits with existing tertiary filters. No upgrades required, however, ECA	

WWTP	Growth Recommendations		Level of Treatment Recommendations	
	Infrastructure Option	Non-Infrastructure Opportunity	Infrastructure Option	Non-Infrastructure Opportunity
			will need to be updated to reflect new treatment requirements	
Preston	• None required		• Phosphorus removal (optimization of secondary treatment) at Preston WWTP	None
Hespeler	• Expansion using new technology (MABR or similar)	None	• Phosphorus removal (optimization of secondary treatment) at Hespeler WWTP	None
Ayr	• None required		• None required	
New Hamburg	• None required		• None required	
Wellesley	• Expansion using new technology (granular sludge or similar)	None	• Phosphorus removal (expansion of existing filters) at Wellesley WWTP	• Phosphorus off-setting
St. Jacobs	• Expansion using conventional technology	• Expansion by re-rating	• Phosphorus removal (expansion of existing filters) at St. Jacobs WWTP	• Phosphorus off-setting
Elmira	• Expansion using new technology (granular sludge or similar)	None	• Phosphorus removal (expansion of existing filters) at Elmira WWTP	None
Foxboro	• None required		• None required	
Conestoga	• None required		• None required	
Heidelberg	• None required		• None required	

ES-6.3.3 Enhance Operations and Reduce Energy Use

Opportunities to reduce energy and enhance operations were also considered for the Region's wastewater treatment plants. Recommendations were short-listed based on a business case assessment. A summary of the recommendations to enhance operations and reduce energy usage at the WWTPs is shown in Table ES-5.

Table ES-5 Summary of Operation Enhancement and Energy Usage Reduction recommendations

Item	Benefit	General Findings	Summary of Recommendation
Chemically Enhanced Primary Treatment	<ul style="list-style-type: none"> • Increase digester gas production • Reduce aeration energy demands 	<ul style="list-style-type: none"> • Chemical costs and increase sludge production offset energy savings 	<ul style="list-style-type: none"> • Consider for trial at Waterloo WWTP to document the cost-benefits. No capital investment required.
Sidestream Treatment (Deammonification and Post-Aerobic Digestion Considered)	<ul style="list-style-type: none"> • Reduce overall energy cost • Reduce biosolids production 	<ul style="list-style-type: none"> • Post-aerobic Digestion (PAD) offers greatest savings opportunity to Region 	<ul style="list-style-type: none"> • Consider PAD for sidestream treatment at Kitchener with highest overall payback, if alternative funding available.
Anoxic Selector	<ul style="list-style-type: none"> • Reduce aeration energy cost 	<ul style="list-style-type: none"> • Relatively low capital investment for on-going energy savings 	<ul style="list-style-type: none"> • Integrate with any planned diffuser replacement project (i.e., asset management) or with planned expansion
Automation Upgrades	<ul style="list-style-type: none"> • Reduce chemical and energy usage 	<ul style="list-style-type: none"> • Instrumentation is cost limited payback to larger facilities 	<ul style="list-style-type: none"> • Implement full-scale trial at larger plant (Waterloo or Kitchener) for detailed cost-benefit assessment • Assess results of ortho-phosphate analyzer at Kitchener WWTP for savings potential

Item	Benefit	General Findings	Summary of Recommendation
Co-Digestion	<ul style="list-style-type: none"> • Use high energy waste from industry to produce digester gas 	<ul style="list-style-type: none"> • Competing market for high energy wastes • Potential for good payback at Kitchener and Waterloo WWTP 	<ul style="list-style-type: none"> • Complete market study and conceptual design to finalize business case for Kitchener and Waterloo WWTP
Thermal Hydrolysis Process (THP)	<ul style="list-style-type: none"> • Reduce biosolids production • Increase gas production • Improve dewaterability 	<ul style="list-style-type: none"> • Requires operation of steam system • Significant labour cost in Ontario for plants currently only staffed during daytime 	<ul style="list-style-type: none"> • Can be considered for Kitchener WWTP if alternative funding available.

ES-7. Public and Review Agency Consultation

Public and review agency consultation is a key component of a successful environmental assessment and master plan. The Municipal Class EA process identifies mandatory consultation requirements. The 2018 WWTMP Update has provided several opportunities for participation including:

- + Notice of Commencement advertised to public and issued to review agencies.
- + Five (5) Steering Committee (SC) Meetings, to provide comments and give direction to the Project Team on the development of the WWTMP.
- + Four (4) Planning and Technical Advisory Committee (PTAC) Meetings, to provide comments and advise the Project Team on the development of the WWTMP Update.
- + Two (2) rounds of Public Consultation Centres (PCCs), each round with three (3) PCCs.
- + Notice of Completion advertised to public and issued to review agencies.

ES-8. Implementation Plan

An implementation plan was developed outlining the recommended wastewater infrastructure works required to service the needs of the Waterloo Region to 2051, and identifying non-infrastructure opportunities for further investigation. The implementation plan includes Regional wastewater recommendations, plant-specific recommendations to accommodate growth and meet level of treatment needs, and opportunities to enhance operations and reduce energy use.

Tables ES-6 summarizes the identified wastewater projects and associated capital budget estimates (in 2018 dollars), and anticipated timing.

Table ES-6 Summary of Recommended Infrastructure Option Projects (By Date)

Year	Project	Cost (2018 \$)
Short-Term (2018 to 2025)		
2018/19	Spring Valley SPS Short-term Improvements - Construction	\$400,000
2018/20	Waterloo & St Jacobs WWTP Optimization Study	\$900,000
2018/20	Hespeler WWTP Short-term Upgrades - Engineering	\$1,650,000
2018/20	Hespeler WWTP Short-term Upgrades - Construction	\$14,000,000
2019	St. Jacobs WWTP Short-term Improvements - Conceptual Design	\$100,000
2019/2020	I/I Reduction Study for Wellesley WWTP	\$300,000
2019/2020	I/I Reduction Study for Ayr WWTP	\$300,000
2019/20	Preston WWTP Process Optimization Study	\$200,000
2019/20	Kitchener WWTP Automation Upgrades	\$500,000
2019/20	Baden & Morningside SPS Optimization Study	\$200,000
2019/20	Spring Valley SPS Upgrades - Class EA and Conceptual Design	\$500,000
2019 to 2028	I/I Reduction and Water Re-use Program	\$100,000 per year
2020	Hespeler WWTP Nitrification Upgrades - Conceptual Design	\$100,000
2020	Elmira WWTP Optimization Study	\$300,000
2020/21	St. Jacobs WWTP Short-term Improvements - Engineering	\$500,000
2020/21	Energy Neutral Opportunities Study	\$800,000
2020/22	Hespeler WWTP Nitrification Upgrades - Engineering	\$1,000,000
2021/22	Elmira WWTP Short-term Improvements - Engineering	\$500,000

Year	Project	Cost (2018 \$)
2021	Preston WWTP Process Optimization	\$200,000
2021	St. Jacobs WWTP Short-term Improvements - Construction	\$2,500,000
2021/22	Waterloo WWTP Automation Upgrades	\$400,000
2021/22	Kitchener WWTP Gas Production Enhancement Study	\$500,000
2021/22	Hespeler WWTP Nitrification Upgrades - Construction	\$6,000,000
2021/24	Spring Valley SPS Upgrades - Engineering	\$1,500,000
2021/23	Waterloo WWTP Expansion - Class EA and Conceptual Design	\$1,500,000
2022	Elmira WWTP Short-term Improvements - Construction	\$2,500,000
2023/24	Galt WWTP Automation Upgrades	\$400,000
2023/24	Spring Valley SPS Upgrades - Construction	\$12,000,000
2023/25	St. Jacobs WWTP Expansion - Class EA and Conceptual Design	\$300,000
2023/28	Waterloo WWTP Expansion - Engineering	\$6,000,000
2024/25	Elmira WWTP Expansion - Class EA and Conceptual Design	\$400,000
Mid-Term (2026 to 2033)		
2025/29	St. Jacobs WWTP Expansion - Engineering	\$1,200,000
2026/28	Waterloo WWTP Expansion - Construction	\$54,000,000
2026/30	Elmira WWTP Expansion - Engineering	\$2,000,000
2028/29	St. Jacobs WWTP Expansion - Construction	\$10,800,000
2028/29	Wellesley WWTP Optimization and Phosphorus Off-setting Study	\$200,000
2028/30	Elmira WWTP Expansion - Construction	\$15,000,000
2030/31	Wellesley WWTP Expansion - Class EA and Conceptual Design	\$300,000
2030/31	East Side Lands - Class EA Update and Conceptual Design	\$400,000
2032/35	Wellesley WWTP Expansion - Engineering	\$1,000,000
2032/33	East Side Lands Kitchener Diversion - Engineering	\$4,000,000
Long-term (Beyond 2033)		
2034/35	Wellesley WWTP Expansion - Construction	\$7,000,000
2034/35	East Side Lands Kitchener Diversion - Construction	\$30,000,000
2036/38	Hespeler WWTP Expansion - Class EA and Conceptual Design	\$700,000
2039/43	Hespeler WWTP Expansion - Engineering	\$1,900,000
2041/43	Hespeler WWTP Expansion - Construction	\$13,600,000

1. Introduction

The Regional Municipality of Waterloo (Region) completed a Wastewater Treatment Master Plan (WWTMP) in 2007 that provided strategic long-term planning for the Region's wastewater treatment services and recommended preferred alternatives to meet growth needs to the year 2041. In light of recent trends in wastewater flows and population growth, regulatory requirements, climate patterns and river water quality, the Region has initiated a study to update the WWTMP. The goal of this study (the 2018 WWTMP Update) was to develop a current, comprehensive, cost-effective and feasible strategy to address the anticipated wastewater treatment needs of the Region over the next 35 years that is consistent with the Region's 2015-2018 Strategic Plan.

The 2018 WWTMP Update was completed under the Environmental Assessment Act in accordance with Municipal Class Environmental Assessment (EA) requirements, and provides an overall plan for the upgrade and/or expansion of the Region's wastewater facilities until the year 2051. Recommendations have been developed to accommodate future population growth, meet level of treatment needs, enhance operations and reduce energy use. In addition to facility-specific recommendations, recommendations benefitting all Regional wastewater facilities were also identified. An implementation plan was also developed to identify the recommended timing and financial impacts for the master plan growth and treatment recommendations.

1.1 Background

The Region is an upper tier municipal government, providing municipal services to seven local area municipalities with a total population of approximately 550,000 people. The Region owns thirteen (13) wastewater treatment plants (WWTPs), one (1) wastewater residuals processing facility, seven (7) wastewater pumping stations, and two wastewater collection systems (Ayr in the Township of North Dumfries and Wellesley in the Township of Wellesley), treating approximately 66 million cubic meters of wastewater annually. Wastewater facilities are operated and maintained by the Ontario Clean Water Agency (OCWA), under contract to the Region. Most of the collection systems and pumping station infrastructure that conveys wastewater to the Region's treatment facilities are owned, managed and operated by the area municipalities (City of Cambridge, City of Kitchener, City of Waterloo, Township of Wilmot, and Township of Woolwich).

Wastewater flows in the Region have declined from 2007 to present by approximately 15% as a result of water conservation in the residential community, reduction of water use in the non-residential sector, and climate change impacts. The Province of Ontario Places to Grow: Growth Plan for the Greater Golden Horseshoe (Ontario Ministry of Infrastructure, June 2006) forecasts were used in the calculation of flow projections for the 2007 WWTMP. Since the completion of the 2007 WWTMP Update, Places to Grow Amendment 2 (P2GA2) has been released (Hemson, June 2013). P2GA2 updated and extended the time horizon of the growth forecast to 2041 for single-tier and upper-tier municipalities in the Greater Golden Horseshoe.

While population and employment growth in the Region remains strong, the Region is experiencing moderate population growth relative to the projections in P2GA2. A moderate growth forecast was developed by the Region's Planning Development & Legislative Services Department (referred to as the Region's Planning Department) to better support the planning of infrastructure needs and capital budgets, including the 2018 WWTMP Update.

On behalf of the Region, CIMA Canada Inc. (CIMA) is updating the Region's WWTMP to reflect the current predicted increase in population, along with wastewater flows and changing regulations (such as targets to reduce phosphorus loadings to Lake Erie). The updated 2018 WWTMP identifies and recommends the expansions and upgrades for the wastewater facilities until the year 2051.

1.1.1 Wastewater Treatment Plants

The Region owns thirteen (13) treatment plants that have been reviewed as part of this WWTMP over the 35-year planning period:

- + Kitchener WWTP
- + Waterloo WWTP
- + Galt WWTP
- + Preston WWTP
- + Hespeler WWTP
- + Elmira WWTP
- + New Hamburg WWTP

- + Ayr WWTP
- + St Jacobs WWTP
- + Wellesley WWTP
- + Alt-Heidelberg WWTP
- + Foxboro Green WWTP
- + Conestogo WWTP

1.1.2 Sewage Pumping Stations

The Region owns seven (7) sewage pumping stations (SPS) including:

- + Spring Valley SPS
- + Bridgeport SPS
- + Baden SPS
- + Morningside SPS
- + Rose Street SPS
- + Ayr SPS
- + Nith River Way SPS

Figure 1 shows the location of key wastewater infrastructure in the Region. Further descriptions of WWTPs and SPSs are provided in Section 4.



Figure 1 Region of Waterloo Wastewater Infrastructure

1.2 Study Objectives

The Region initiated this master plan update to identify and evaluate wastewater treatment projects, new technologies, and servicing strategies to meet the long term needs of residents and businesses until 2051. The key objectives of the 2018 WWTMP Update are as follows:

1. Development of population and flow projections based on the moderate population growth scenario developed by the Region's Planning Department;
2. Assessment of opportunities and constraints for the Region's existing wastewater treatment plants and pumping stations;
3. Review of short and long-term servicing plans for the area referred to as the East Side Lands (ESL) (located east of the Grand River in the Township of Woolwich, the City of Cambridge, and the City of Kitchener);
4. Development of evaluation criteria and methodology to identify recommended alternatives;
5. Development of alternatives to meet servicing needs and achieve the Region's objectives;
6. Evaluation and identification of recommended alternatives;
7. Development of an implementation plan and cash flow for the recommended alternatives.

1.3 Master Planning Process

1.3.1 Class Environmental Assessment Master Planning Process

The 2018 WWTMP Update was undertaken under the Environmental Assessment Act in accordance with Municipal Class EA requirements (October 2000, as amended in 2007, 2011 and 2015).

Generally, the Municipal Class EA outlines the planning and approval process for municipal projects including wastewater projects. Individual projects subject to the Municipal Class EA process fall into four schedules of undertakings including Schedule A, A⁺, B or C, depending on the type of project and its potential environmental effects. The Municipal Class EA planning process is illustrated in Figure 2.

EXHIBIT A.2

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA

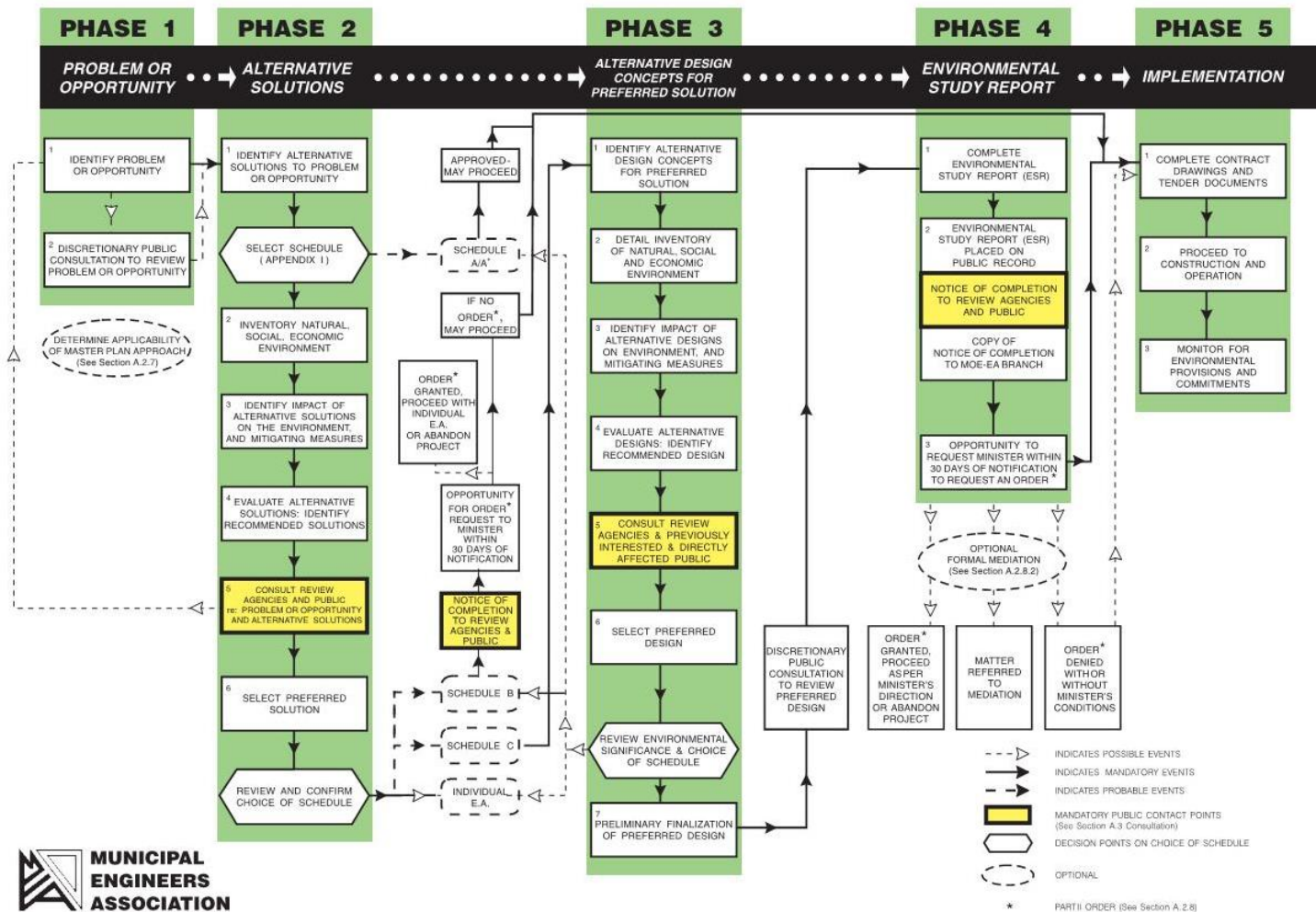


Figure 2 Municipal Class EA Process

The Master Plan provisions of the Municipal Class EA allow municipalities to develop long range plans for integrated infrastructure requirements. The 2018 WWTMP Update represents Phases 1 and 2 of the Class EA process. Projects that result from the Master Planning process will be subject to the requirements of the Municipal Class EA process which may include further assessment of Schedule B activities. In addition, Phase 3 and Phase 4 requirements may need to be carried out for any Schedule C activities identified in the Master Plan.

The following section provides an overview of the study approach to completing Phases 1 and 2 of the Class EA for the 2018 WWTMP Update.

1.3.1.1 Phase 1 – Problem and Opportunity Statement

Phase 1 of an environmental assessment is the process of identifying the problem or opportunity. This determines the scope of the project, as well as the objective.

The Region completed a WWTMP in 2007 (Earth Tech, 2007) to provide strategic long-term planning for the Region's wastewater treatment services and infrastructure to year 2041. Since the completion of the 2007 WWTMP, numerous changes that may impact the approach for wastewater treatment have transpired, including changing trends in wastewater flows and population growth, regulatory requirements, climate patterns, river water quality and major upgrades to a number of treatment plants (including the Kitchener and Waterloo WWTPs for enhanced nitrification and improved effluent quality).

The 2018 WWTMP Update is an update of the 2007 WWTMP based on recent trends in population growth, wastewater flows, and environmental regulations. The purpose of the update was to evaluate the status of existing wastewater servicing systems, provide recommendations to address existing servicing constraints, and provide the framework to meet the wastewater servicing needs for the Region up to the planning horizon of 2051.

1.3.1.2 Phase 2 – Identification and Evaluation of Alternative Solutions

As part of Phase 2 of the Class EA process, the 2018 WWTMP Update identified and evaluated alternative solutions to recommend the long-term wastewater servicing plan for the Region's wastewater treatment plants and pumping stations until the year 2051 to accommodate growth and/or level of treatment.

In order to develop a robust long-term servicing plan for the Region's wastewater treatment plants and pumping stations, both infrastructure options and non-infrastructure opportunities were identified for facilities as described below:

- + Infrastructure options are approaches that are more widely accepted by the industry and there is a high level of confidence that approvals could be obtained (such as expansions to existing processes).
- + Non-infrastructure opportunities represent new approaches and will require additional studies and consultation to confirm feasibility and approvals. It can be noted that some new minor infrastructure may be required for non-infrastructure opportunities; however, these opportunities are more focused on changes to operations or implementing new programs to achieve objectives.

To ensure the Region has a fully funded and feasible plan in place following the completion of the 2018 WWTMP Update, infrastructure options were recommended as the preferred option for each facility to meet growth and level of treatment needs, with non-infrastructure opportunities noted where available for further investigation. In addition to facility specific recommendations, regional wastewater options including infiltration/inflow reduction, watershed management, water re-use, resource recovery, industrial pre-treatment and asset management, were also reviewed.

1.3.1.3 Public Consultation During the Master Plan Update

A significant component of the Municipal Class EA process is consultation with the public. As part of the Class EA process, consultation with the public and agencies must be documented at each phase of the project. At the initiation of the 2018 WWTMP Update, a Public Consultation Plan was developed to outline a strategy for informing the general public about the project and soliciting input during the planning process. The main components of the consultation program included:

- + Notice of Commencement

Advertisements were placed in local newspapers and the Region's website informing the public of the commencement of the WWTMP Update. In addition, the local area municipalities, neighbouring municipalities, provincial agencies, federal agencies, First Nations and the Grand River Conservation Authority (GRCA) were notified by letter.

+ Steering Committee (SC) Meetings

A SC was formed to provide comments and give direction to the Project Team on the development of the WWTMP Update. It consisted of the project consultant, assigned Regional Councillors, and representatives of the Region's Transportation and Environmental Services Department, Planning, Development, and Legislative Services Department, and Financial Services and Development Finances Department. A total of five (5) SC meetings were held throughout the project.

+ Planning and Technical Advisory Committee (PTAC) Meetings

A PTAC was formed to provide comments and advise the Project Team on the development of the WWTMP Update. It consisted of the project consultant, representatives of Regional departments, local area municipalities, Grand River Conservation Authority (GRCA), Ministry of the Environment and Climate Change (MOECC), Greater KW Chamber of Commerce, and academics. A total of four (4) PTAC meetings were held throughout the project.

+ Public Consultation Centres (PCCs)

Two rounds of PCCs (March 2017 and December 2017) were held in Cambridge, Kitchener, and Waterloo, resulting in a total of six PCCs. Advertisements were placed in local newspapers and the Region's website informing the general public of the PCCs. Notifications by letter were also sent to groups who received notification of the Notice of Commencement above, and any other parties who requested to be part of the notification list. Approximately 21 people attended the round of PCCs in March 2017 and 36 attended the round of PCCs in December 2017. People were generally in support of the recommended alternatives presented.

+ Notice of Completion

A Notice of Completion of the 2018 WWTMP Update will be placed in the local newspapers and the Region's website informing the general public of the public review period for the Final Report in accordance with the Municipal Class EA Process. Notifications by letter will also be sent to groups who received notification of the Notice of Commencement above, and any other parties who requested to be part of the notification list. All comments received will become

part of the updated project file. Due to summer holidays, the review period will be extended to 60 days instead of the minimum required 30 days and will run from July 16, 2018 to September 14, 2018.

2. Growth Requirements

A key component of any WWTMP update is to determine the existing and future wastewater flows and loadings. The 2018 WWTMP Update focused on the long-term planning horizon to the year 2051. The determination of growth requirements included:

- + The confirmation of existing conditions;
- + Future service needs based on the Region's latest population projections and average historical sewage flows for the WWTPs; and
- + Influent loadings for unit process capacity estimates.

As mentioned in Section 1, a moderate growth scenario developed by the Region's Planning Department for population and flow projections was used for the development of alternatives and making infrastructure recommendations as part of the 2018 WWTMP Update. During the development of alternatives, a sensitivity analysis was conducted to determine potential infrastructure needs by looking at variations in the projections should higher (P2GA2 projections) or lower growth rates or trends such as improved water conservation be realized in the future.

Details regarding the existing conditions and projections used to identify future servicing needs are provided in the following sections.

2.1 Existing Conditions

The historic 5-year average per capita flows (2011-2015) derived from the Region's 2016 Water and Wastewater Monitoring Reports (WWWMR) were reviewed and used as the basis for future flow projection estimates.

A summary of the historic 5-year average per capita flows, along with the existing capacity, population and average day flow for each WWTP are presented in Table 1. A summary for each SPS, along with peak wet weather flow, is presented in Table 2. It is noted that Galt, Preston, St Jacobs and Elmira have higher per capita flow rates, which is attributed to additional contributions from industrial sources and/or historical infiltration and inflow (I/I) issues experienced at these WWTPs.

Table 1 Historic Average Flows to Wastewater Treatment Plants

Wastewater Treatment Plant	WWTP Rated Capacity (m³/d)	Existing Service Population (2016) ⁽¹⁾	Existing Average Day Flow (m³/d)	Historic Average Per Capita Flow (m³/cap/d)
Kitchener	122,745	242,626	71,842	0.296
Waterloo	57,500	139,527	46,602	0.334
Galt	56,800	89,236	36,150	0.405
Preston	16,860	21,961	9,503	0.433
Hespeler	9,320	25,722	7,079	0.275
Ayr	3,000	5,198	1,425	0.274
New Hamburg	6,900 ⁽²⁾	14,574	4,264	0.293
Wellesley	1,100	3,508	818	0.233
St Jacobs	1,450	1,993	990	0.497
Elmira	7,800	10,484	4,479	0.427
Alt-Heidelberg	130	268	60	0.236
Foxboro Green	150	409	110	0.273
Conestogo	148	265	40	0.169

Notes:

1. Based on population provided by the Region.
2. This capacity is upon completion of the current Phase 2 expansion.

Table 2 Historic Average Flows to Sewage Pumping Stations

Pump Station	SPS Firm Capacity (L/s)	Existing Service Population (2016) ⁽¹⁾	Existing Average Day Flow (L/s)	Existing Peak Wet Weather Flow (L/s) ⁽²⁾	Historic Average Per Capita Flow (m³/cap/d)
Bridgeport	136	7,026	32 ⁽³⁾	85	0.394
Spring Valley	245	10,772	46 ⁽⁴⁾	207	0.366
Baden	187	5,436	16 ⁽⁵⁾	185	0.255
Morningside	248	14,574	42 ⁽⁶⁾	206	0.250
Rose Street	80	5,198	17 ⁽⁷⁾	38	0.279
Ayr ⁽⁸⁾	46	N/A	N/A	N/A	0.279
Nith River Way	3.9	N/A – Dedicated Development SPS, No Projected Growth.			

Notes:

1. Based on population provided by the Region.
2. Based on fifteen-minute average of historical flow monitoring data.
3. Based on historic station influent flow monitoring data (July 8, 2015 to June 24, 2016).
4. Based on historic station influent flow monitoring data (April 29, 2015 to June 24, 2016).
5. Based on historic station discharge flow SCADA monitoring data (June 1, 2013 to June 30, 2016).
6. Based on historic station discharge flow SCADA monitoring data (Jun1 2008 to October 31 2012).
7. Based on historic station discharge flow SCADA monitoring data (January 1, 2013 to November 1, 2015).
8. The Ayr SPS is under construction and therefore there is no existing population or station flow data available in 2016. It is assumed the station has the same per capita flow rate as Rose Street SPS, as both stations service the Village of Ayr in the Township of North Dumfries.

2.2 Future Servicing Needs

As mentioned in Section 1, a moderate growth scenario developed by the Region's Planning Department was used for population projections within Waterloo Region. The population projections to 2051 for each individual WWTP and SPS service area are shown in Table 3 and Table 4, respectively.

Table 3 Future Population Projections for WWTPs

Service Area	Population								
	2016	2021	2026	2031	2036	2041	2046	2051	Build-out
Kitchener ⁽¹⁾	242,630	257,160	273,850	291,210	308,190	323,360	337,207	348,360	378,150
Waterloo ⁽²⁾	139,530	148,200	155,180	161,470	167,380	172,240	177,010	181,220	-
Galt	89,240	93,970	98,540	103,250	108,250	113,310	117,540	120,980	143,350
Preston ⁽¹⁾	21,960	23,320	24,350	25,060	25,690	26,310	26,910	27,480	29,280
Hespeler	25,720	26,340	26,670	27,080	28,520	31,330	33,190	35,980	42,670
Ayr	5,200	6,350	7,520	8,270	8,640	9,060	9,620	10,060	12,620
New Hamburg	14,570	15,540	16,050	16,540	17,830	19,990	21,510	23,480	28,430
Wellesley ⁽³⁾	3,510	3,570	3,630	3,880	4,390	4,730	5,080	5,410	-
St Jacobs ⁽³⁾	1,990	2,330	2,520	2,670	2,800	2,900	2,990	3,080	-
Elmira	10,480	11,490	13,460	16,270	17,620	19,130	20,870	22,130	29,860
Alt-Heidelberg	270	270	270	270	270	270	270	270	280
Foxboro Green	410	410	400	400	410	420	420	420	420
Conestogo	270	260	260	260	270	270	270	270	260
East Side Lands	630	2,660	4,580	5,750	7,410	9,240	12,180	14,300	45,730
Unserviced Areas	30,550	31,950	32,890	33,410	34,250	35,260	37,560	42,780	-
Total	586,950	623,810	660,160	695,790	731,920	767,790	802,620	836,220	-

Notes:

1. Population projections do not include the ESL.
2. For Waterloo, the amount of greenfield land is limited within the urban boundary and there is a high potential for intensification, therefore, no build-out population is provided for this service area.
3. For Wellesley and St Jacobs, the population forecasts from the Townships were higher than the Townships have land to accommodate within the settlement areas. For this reason, projections indicate populations greater than the build-out populations of the settlement area and therefore build-out populations were not used for these two communities.

Table 4 Future Population Projections to Sewage Pumping Stations

SPS	Population							
	2016	2021	2026	2031	2036	2041	2046	2051
Bridgeport	7,030	7,360	7,630	7,860	8,110	8,530	8,880	9,180
Spring Valley	10,770	11,370	11,950	12,450	12,980	13,520	14,040	14,540
Baden	5,440	5,600	5,800	6,070	6,830	8,090	9,000	10,100
Morningside	14,570	15,540	16,050	16,540	17,830	19,990	21,510	23,470
Rose St	5,200	5,910	6,400	6,650	6,770	6,850	6,920	6,980
Ayr	N/A ⁽¹⁾	440	1,120	1,620	1,870	2,210	2,700	3,080
Nith River Way	N/A – Dedicated Development SPS, No Projected Growth.							

Notes:

1. Ayr SPS is currently under construction and therefore there is no current population data available in 2016.

The total population projections to 2051 throughout the Region are shown in Figure 3, along with 2007 WWTMP forecast, and P2GA2 forecast, for comparison.

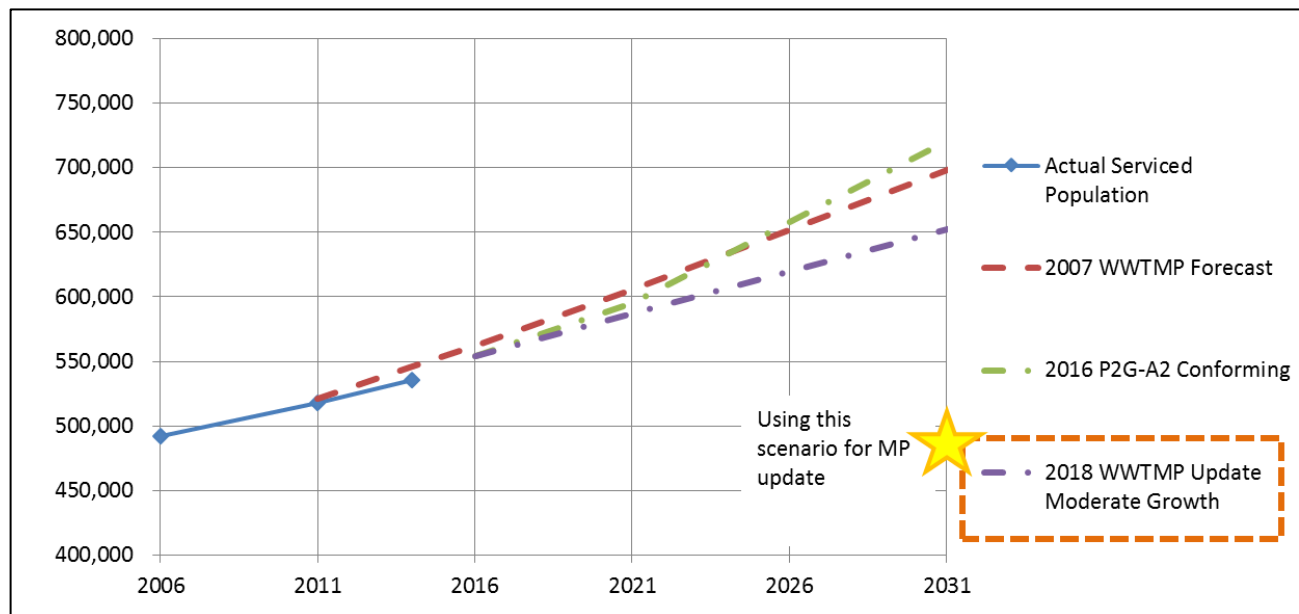


Figure 3 Population Projections

The projected average day wastewater flows for each individual WWTP and SPS were estimated based on the population growth projections and the average per capita flows derived from the Region's 2016 WWWWMR (except for ESL, for which

projected flows were calculated using projections specific to this study area), to provide an indication of the wastewater treatment requirements in the future.

The historic average per capita flow from the 2016 WWWMR was considered to be a conservative value for projecting future flows. This per capita rate includes combined wastewater discharges from residential, industrial, commercial and institutional (ICI), and extraneous flows such as I/I. If additional water conservation and I/I corrective programs are implemented and effective, lower future wastewater flows are likely to occur.

It can also be noted that using the historical average per capita flow assumes the ratio of ICI to residential flow rates in the future is similar to the current ratio in each service area. This approach was considered best suited based on the information currently available and the level of detail for a master planning process, with the exception of the Elmira WWTP. The Elmira WWTP currently has high industrial flow and loading contributions; therefore, it was considered more appropriate to use projections that represent a mid-point between existing and typical residential per capita rates.

For the ESL area, future flows were forecasted using detailed population projections developed through the ESL Sanitary Servicing Class EA (Associated Engineering, ongoing). As it is thought that the majority of ICI growth within the Region will be within the ESL study area, using projections specific to the ESL study area (rather than adopting a historical average per capita from an existing catchment area) was appropriate to ensure the greater ICI growth is captured in the future projections.

The flow projections to 2051 for WWTPs and SPSs are shown in Table 5 and Table 6, respectively. As the flow rates approach 85% of the WWTP/SPS capacity, the planning process for expansion should be triggered (i.e. Class EA) (MOECC, 1995).

Table 5 Future Wastewater Flow Projections to WWTPs

Service Area	Average Day Flow (m ³ /d)								Rated Capacity	Year to Reach 85% Rated Cap. ⁽²⁾	Year to Reach 100% Rated Cap.
	2016	2021	2026	2031	2036	2041	2046	2051			
Kitchener ⁽¹⁾	71,840	76,150	81,090	86,230	91,250	95,750	99,850	103,150	122,745	>2051	>2051
Waterloo	46,600	49,500	51,830	53,930	55,910	57,530	59,120	60,530	57,500	2020	2041
Galt	36,150	38,070	39,920	41,830	43,850	45,900	47,620	49,010	56,800	2048	>2051
Preston ⁽¹⁾	9,500	10,090	10,540	10,840	11,120	11,380	11,640	11,890	16,860	>2051	>2051
Hespeler	7,080	7,250	7,340	7,450	7,850	8,620	9,130	9,900	9,320	2036	2047
Ayr	1,430	1,740	2,060	2,270	2,370	2,480	2,640	2,760	3,000	2043	>2051
Baden/ New Hamburg	4,260	4,550	4,700	4,840	5,220	5,850	6,290	6,870	6,900	2041	2051
Wellesley	820	830	850	900	1,020	1,100	1,180	1,260	1,100	2032	2041
St Jacobs	990	1,160	1,250	1,330	1,390	1,440	1,490	1,530	1,450	2025	2042
Elmira	4,480	4,910	5,750	6,950	7,530	8,170	8,920	9,460	7,800	2030	2039
East Side Lands	360	1,540	2,650	3,330	4,290	5,350	7,050	8,270	-	-	-
Unserviced Areas	8,680	9,080	9,350	9,500	9,730	10,020	10,680	12,160	-	-	-

Notes:

1. Flow projections do not include the ESL.
2. As the flow rates approach 85% of the WWTP capacity, the planning process for expansion should be triggered (i.e. Class EA) (MOECC, 1995).

Table 6 Future Projected Flows to Sewage Pumping Stations

SPS	Peak Wet Weather Flow (L/s)								Firm Cap. (L/s)	Year to Reach 85% Firm Cap.	Year to Reach 100% Firm Cap.
	2016	2021	2026	2031	2036	2041	2046	2051			
Bridgeport	85	90	90	100	100	105	110	115	136	>2051	>2051
Spring Valley	210	215	220	225	235	240	245	250	245	2017	2045
Baden	185	185	190	190	200	210	215	225	187	<2016	2021
Morningside	205	215	220	220	230	250	260	270	248	2019	2041
Rose Street	40	45	50	50	55	55	55	50	80	>2051	>2051
Ayr ⁽¹⁾	N/A	15	20	25	30	30	35	40	46	2048	>2051
Nith River Way	N/A – Dedicated Development SPS, No Projected Growth.								3.9	N/A – No Projected Growth	

Notes:

1. Ayr SPS is currently under construction, with a firm capacity of 46 L/s for Phase 1 and 84 L/s for Phase 2. There is no existing population data available in 2016.

2.3 Sensitivity Analysis

The moderate growth scenario population and flow projections were used in the development of alternatives and making primary infrastructure recommendations as part of the 2018 WWTMP Update. During the development of alternatives, a sensitivity analysis was conducted to determine infrastructure needs should higher (P2GA2 projections) or lower growth rates or trends such as improved water efficiencies be realized in the future. Additional details are provided in Technical Memorandum (TM) 11 - Sensitivity Analysis, available in Appendix M. Three (3) scenarios were developed for the sensitivity analysis:

- + Population growth sensitivity
- + Per capita flow sensitivity
- + Inflow/infiltration sensitivity

2.3.1 Population Growth Sensitivity Analysis

Population growth sensitivity was assessed to determine infrastructure needs based on adjusted growth rates as follows:

- + 15% higher growth rate than the moderate growth scenario
- + 15% lower growth rate than the moderate growth scenario
- + P2GA2 growth scenario

For a given per capita flow, wastewater flow is directly proportional to population. As a result, higher growth rates will result in wastewater treatment facilities approaching their rated capacity sooner than compared to a lower growth rate.

2.3.2 Per Capita Flow Sensitivity Analysis

Per capita flow sensitivity was assessed to determine infrastructure needs based on adjusted flow rates. It is important to note that for the per capita flow sensitivity analysis, the population forecasts were kept as the moderate growth scenario and the per capita rate was the only parameter changed. To understand the sensitivity of timing recommendations based on per capita flows, the following boundaries were considered:

- + Upper boundary based on using “adjusted flows” from the Region’s annual WWWMR. This represents 85% confidence level for per capita flows to account for seasonal fluctuations.
- + 15% decrease in per capita flows relative to the historic average.

These boundary conditions were applied to both the existing population base as well as the new growth in each service area. This accounts for many existing homes that are upgrading to water conserving toilets, faucets and appliances.

It is important to note that when considering changes to per capita flows, the overall loadings of key wastewater constituents (i.e., BOD, TSS, etc.) will remain unchanged since loadings are directly proportional to population. Overall, higher per capita flows will result in a more dilute, lower concentration wastewater influent, while lower per capita flows will result in a more concentrated wastewater influent. As a result, for the WWTPs where the capacity limiting processes are governed by loadings rather than hydraulic throughput (e.g. aeration tankage, oxygenation system, secondary clarifier solids loading rate, and digestion), there is no impact on timing of major works based on per capita flow sensitivity.

For the WWTPs where the capacity limiting processes are governed by hydraulic throughput rather than loadings, lower per capita flows will result in a slight delay in the plant expansion timeline, while higher per capita flows will result in an earlier plant expansion timeline compared to the baseline conditions.

A per capita sensitivity review was completed for plants that require expansion within the 2051 timeframe based on the moderate growth scenario including:

- + Waterloo WWTP
- + Hespeler WWTP
- + Wellesley WWTP
- + St Jacobs WWTP
- + Elmira WWTP

For the Waterloo, Hespeler and Elmira WWTPs, the capacity limiting process will be aeration tankage and/or oxygenation systems, which are determined based on

loadings. As a result, there is no impact on timing of major works for these plants with changes of per capita flows.

For the Wellesley and St Jacobs WWTPs, the capacity limiting processes are governed by hydraulic rates. As a result, changes in per capita flows will have impacts on the plant expansion timeline as discussed above.

2.3.3 Inflow/Infiltration Sensitivity Analysis

I/I sensitivity was assessed to determine infrastructure needs based on adjusted peak flow rates for the following wastewater facilities that historically have higher than typical I/I rates:

- + Wellesley WWTP
- + St Jacobs WWTP
- + Elmira WWTP

Reduced I/I has the potential to reduce both the average per capita flow as well as the extreme wet weather flows handled at the facility. The first component (per capita flow reduction) is already considered as part of the per capita flow sensitivity analysis. The I/I sensitivity analysis focused on the impacts of reduced peak wet weather flows on infrastructure needs. In general, lower wet weather flows can reduce infrastructure needs on processes designed around peak flows including headworks, primary and secondary clarifiers, tertiary filters and disinfection.

The following scenarios were used for I/I sensitivity analysis:

- + 15% reduction in peak flow for the Wellesley WWTP, which will allow the capacity limiting processes (i.e. secondary clarifier SOR) during high flows at the plant to meet the current rated capacity of the plant.
- + 25% reduction in peak flow for the St Jacobs and Elmira WWTPs, which will allow the capacity limiting processes (i.e., tertiary filtration and UV disinfection at the St Jacobs WWTP; and primary clarification SOR at the Elmira WWTP) during high flows to meet the current rated plant capacity.

The Wellesley, St Jacobs and Elmira WWTPs each have treatment processes that are constrained based on historical peak flows that are higher than the design peak

flows. If the I/I issues within the WWTP service areas are addressed, there may be opportunity to defer upgrades and/or expansions.

2.3.4 Summary

The impact of the sensitivity scenarios varies for individual plants based on specific growth forecasts, plant capacity, and unit process constraints. Table 7 summarizes the sensitivity scenarios for plants that are expected to require an expansion within the planning horizon to 2051.

Implementation timelines are presented to identify where early budgeting for projects may be considered to mitigate overall risks. For St Jacobs and Elmira WWTPs, early projects are recommended to address unit process capacity limitations, which are reached well in advance of the expansion planning timelines.

Table 7 Sensitivity Analysis Timeline Summary for Plants Expected to Require an Expansion by 2051

WWTP	Year to Reach 85% of Rated Capacity						
	Growth (Baseline) (1)	Population Sensitivity			Per Capita Sensitivity	I/I Sensitivity	Recommended Timeline
		-15% Pop. Growth(2)	+15% Pop. Growth(3)	P2GA2 Sensitivity (4)			
Waterloo	2020	2021	2019	2022	2021(5)	-	Begin Expansion Planning in 2021
Hespeler	2036	2037	2035	2035	2036(5)	-	Begin Expansion Planning in 2036
Wellesley	2032	2033	2032	2024	2027(5)	2033(6)	Begin Expansion Planning in 2030
St Jacobs	2025	2027	2023	2031	2021(5)	2019(7)	Filter/Disinfection Upgrades in 2020
Elmira	2030	2032	2028	2030	2021(8)	2027(9)	Bioreactor Upgrades Assessment in 2020

Notes:

1. Timing to reach 85% of rated capacity based on moderate growth (baseline) scenario.
2. Timing to reach 85% of rated capacity based on 15% decrease of moderate growth scenario.
3. Timing to reach 85% of rated capacity based on 15% increase of moderate growth scenario.
4. Timing to reach 85% of rated capacity based on P2GA2 scenario.
5. Timing for 85% confidence level per capita flows to reach 85% of aeration tank/oxygenation system capacity (loading).
6. Secondary SOR limitations without I/I reduction.
7. Filtration and UV disinfection capacity without I/I reduction.
8. Capacity limited by loadings to bioreactors and oxygenation capacity.
9. Primary SOR limitations without I/I reduction.

3. Receiving Water Assessment

As part of this Master Plan update, alternatives have been identified to accommodate growth and meet level of treatment requirements. Level of treatment requirements for these alternatives is based on the constraints of the downstream receiving waters at each of the thirteen (13) WWTPs (refer to Section 6 of this report).

In addition to the receiving water limitations, the Canada-Ontario Draft Action Plan for Lake Erie (Draft Action Plan), which is expected to be finalized in 2018, proposes a new legal effluent discharge limit of 0.5 mg/L total phosphorus (TP) for all municipal WWTPs with an average daily flow of 3,780 m³/d or greater.

Currently, seven of the Region WWTPs (Kitchener, Galt, Elmira, New Hamburg, Waterloo, Hespeler and Preston WWTPs) have average daily flow above the 3,780 m³/day criteria. The Kitchener, Galt, Elmira, and New Hamburg WWTPs already have phosphorus removal treatment that meets the proposed limit in the Draft Action Plan of 0.5 mg/L of TP. The Waterloo, Hespeler and Preston WWTPs need to consider upgrades or operational improvements to meet the new effluent TP criteria.

The Wellesley and St Jacobs WWTPs, while not having flow above the 3,780 m³/d criteria, are expected to have changes to effluent quality requirements when expanded to accommodate future growth. The Elmira WWTP, while having met the Lake Erie targets, is also expected to have changes to effluent quality requirements, when expanded, to accommodate future growth. Therefore, the following plants are expected to have effluent quality requirement changes based on expansion to accommodate growth and/or the Lake Erie targets:

- + Waterloo (expansion and Lake Erie targets)
- + Preston (Lake Erie targets)
- + Hespeler (expansion and Lake Erie targets)
- + Wellesley (expansion)
- + St Jacobs (expansion)
- + Elmira (expansion)

In support of the evaluation of alternatives, anticipated future effluent objectives were identified for each of the WWTPs above. This included reviewing previously

completed Assimilative Capacity Studies (ACSs), recent water quality data from the Region's Surface Water Quality Monitoring Program (SWQMP), and other available studies related to the receiving waters (refer to Section 3.3 for details).

3.1 Background Review

The Region carries out significant on-going river monitoring in all of the receiving streams for the WWTPs and has completed a number of ACSs and/or receiving water impact studies. As part of the 2018 WWTMP Update, this information was reviewed to suggest appropriate future effluent objectives and make recommendations on level of treatment for the facilities. The goal is to ensure protection of the receiving water environment and be consistent with current and future regulatory trends.

3.1.1 Surface Water Quality Monitoring Program

The Region initiated a SWQMP in summer 2007 as part of the 2007 WWTMP. The program was initially managed by the GRCA, until 2009. Since 2009, the Region has retained LGL to continue the monitoring program. The program monitors the receiving water near ten of the Region's WWTPs (Kitchener, Waterloo, Galt, Preston, Hespeler, Ayr, New Hamburg, Wellesley, St Jacobs and Elmira WWTPs). The goals of the program include:

- + To determine the impact of ten of the Region's WWTPs on the water quality of the receiving water bodies (Grand River, Nith River, Speed River, Conestogo River, and Canagagigue Creek), and
- + To create a water quality database to track changes in water quality over time and allow the Region to continuously monitor and assess the impacts of planned wastewater treatment upgrades on these receiving waters.

Water quality sampling is conducted six times per season at most stations. The seasons are classified as follows:

- + Winter – January and February – coldest water temperatures, under ice;
- + Spring – March and April – spring melt, rain events;
- + Summer – July and August, but can extend to September – low flow; and
- + Fall – October and November.

In addition to the water quality monitoring program, fish and benthic community surveys and longitudinal surveys are carried out periodically within the Grand, Nith and Speed Rivers in the vicinity of the WWTPs. Since the river monitoring program's inception in 2007, a benthic invertebrate community survey and fish survey were conducted in 2009, 2012, and 2015. Longitudinal surveys were carried out in 2010, 2012, 2014 and 2016. Additional details of the SWQMP are provided in TM4 – River Monitoring Program Review, in Appendix E.

3.1.2 Assimilative Capacity Studies

The Region has completed ACSs and/or receiving water impact studies for a number of the Region's receiving streams. Following the completion of the 2007 WWTMP, ACSs were completed in support of the upgrades/expansions that were identified in the short-term. This included the ACS completed for the Kitchener WWTP in 2010 and the ACS completed for the Waterloo and Hespeler WWTPs in 2014.

The GRCA maintains the Grand River Simulation Model (GRSM) for use in reviewing and evaluating impacts on the Grand River due to changes in infrastructure and conditions. As part of the ACSs for the Kitchener, Waterloo and Hespeler WWTPs, the GRSM was used to develop recommendations for the level of treatment required at the plants. One of the key inputs of this model is the baseline WWTP effluent quality, which was assumed the same as the effluent objectives identified in the current Environmental Compliance Approvals (ECA) for the Region's WWTPs. For the 2010 Kitchener WWTP ACS, the 2007 plant effluent flows were used for the baseline flows and the projected future effluent flows of 123,000 m³/d (i.e. the ECA rated capacity of the plant) were used for future model run scenarios for the Kitchener WWTP. For the 2014 Waterloo and Hespeler ACS, the 2011 WWTP effluent flows were used for the baseline flows and the projected 2051 effluent flows of 73,200 and 13,200 m³/d were used for future model run scenarios for the Waterloo and Hespeler WWTPs, respectively.

Following the completion of the ACS, some upgrades have been implemented at these WWTPs, and the impacts of these upgrades on the river water quality have been monitored and assessed through the Region's SWQMP within the Grand and Nith Rivers. A review of the recent data from the SWQMP on the Grand and Nith Rivers was conducted to determine if the current river water quality is in line with data

used for the past ACSs, as the ACS recommended treatment objectives are key assumptions for the 2018 WWTMP Update.

3.2 Effluent Quality Considerations

One of the objectives for the 2018 WWTMP Update is to meet changing regulations with respect to wastewater treatment and effluent quality requirements. Phosphorus and ammonia removal for non-toxic effluent are expected to be key drivers for existing and expanding plants. These parameters are discussed in the following sections.

3.2.1 Nitrogen (Ammonia and Nitrates)

An important consideration for existing and expanding plants is the ammonia loading to receiving waters. The Region has taken significant steps to implement upgrades, including year-round nitrification at its wastewater treatment facilities. The upgrades put in place have achieved significant reductions in ammonia loadings to the receiving waters. The only facility currently (or after on-going upgrades) not providing year-round nitrification for the design rated capacity is the Hespeler WWTP.

There has also been increased interest in nitrate loadings, especially for larger plants in sensitive watersheds. This is primarily being driven by the Conservation Authorities, as a concern regarding aquatic (especially fish) habitat. There is still some uncertainty related to potential requirements for denitrification as the MOECC does not currently have a Provincial Water Quality Objective (PWQO) for nitrate. Nitrate limits and denitrification were not considered as part of this WWTMP Update because they are currently not regulated, but moving forward there should be awareness that regulations may be subject to change as the impacts of nitrates become better understood.

3.2.2 Phosphorus

Total phosphorus is a key water quality parameter for the Grand River watershed and the focus of Lake Erie remedial efforts (i.e., the proposed Canada-Ontario Action Plan for Lake Erie 2017, [Section 1.1]; IJC 2014). Although watershed management is outside of the scope of the WWTMP, the master plan approach will affect watershed management activities over the long term. Since the costs for controlling non-point source phosphorus loads may be seven to ten times less expensive than those for controlling point source loads, such as WWTP effluent quality (Conservation Ontario 2003), opportunities were also reviewed as part of the 2018 WWTMP Update to

control phosphorus loadings to the watershed through investments in non-point source controls as part of a phosphorus offsetting program. Phosphorus trading was also considered as an option, which would allow the shifting of allowable loadings between different plants in the same watershed provided the net loading to the watershed remained unchanged or slightly improved.

3.2.2.1 Existing Conditions

All of the WWTPs that discharge to a surface water body, either discharge directly to the Grand River or to a tributary of the Grand River (i.e. Speed, Nith, Conestogo, and Canagagigue). The Grand River is Policy 2 for total phosphorus, in that surface water concentrations consistently exceed the PWQO (MOE 1994a) of 0.03 mg/L (GRCA 2011).

Several key water quality issues have been identified for the Grand River basin. These include eutrophication of the river system and elevated sediment and nutrient levels in river reaches causing algal blooms in Lake Erie (GRCA 2014). The causes of these issues have been identified as excess inputs of suspended sediment and nutrients (GRCA 2013). Since the watershed is so large and complex, no single point source or area prevails as being the most important or the largest contributor to water quality impairment (GRCA 2013). The export of low-solubility parameters (i.e., suspended sediment/solids, total phosphorus) is driven largely by non-point sources during hydrologic events, with loads peaking during high flows in the spring. In the central portion of the watershed, point sources from wastewater treatment plants contribute almost 75% of the phosphorus loading during summer low flow conditions (GRCA 2013). Impacts to Lake Erie are largely influenced by total seasonal loads; in the spring, phosphorus loading to Lake Erie is estimated to be 300 kg/d, while in the summer it is typically less than 100 kg/day (Stantec, 2014).

3.2.2.2 Lake Erie Basin Limits

To reduce toxic and nuisance algal blooms in Lake Erie, the Great Lakes Water Quality Agreement (GLWQA, adopted in 2014) proposed a binational (i.e., Canada and the United States) load reduction target of 40% (from 2008 loads) of total phosphorus entering the Western and Central Basin of Lake Erie by 2025, with an “aspirational” interim goal of 20% by 2020 (Canada-Ontario Agreement Partners 2017). Domestic action plans will be developed by 2018 to outline strategies for meeting the targets. To this end, the proposed Canada-Ontario Draft Action Plan for

Lake Erie is expected to be finalized in 2018 and meets all of Ontario's binational and domestic commitments related to phosphorus reductions.

The Action Plan applies to tributaries, point and non-point sources entering Lake Erie. A phosphorus reduction target has been proposed for the Western and Central Basins of Lake Erie, however, a target for the Eastern Basin (into which the Grand River discharges) has not been established and requires further scientific assessment. The phosphorus loading to the Eastern Basin is notably lower than to the Western and Central Basins – 12% of the loading is to the Eastern Basin, while the remaining 88% discharges to the Western and Central Basin (Canada-Ontario Agreement Partners 2017). However, the phosphorus load from the Grand River is potentially a factor in nuisance *Cladophora* blooms in the nearshore zone of the Eastern Basin, since Canadian sources and specifically, the Grand River watershed, are the largest phosphorus contributor to the Eastern Basin.

Although the GLWQA targets do not apply to the Grand River watershed at this time, targets for the Eastern Basin are likely to follow. Similarly, it is reasonable to assume many of the proposed actions in the Action Plan (for the Western and Central Basins) will likely carry over as proposed actions for the Eastern Basin.

The proposed actions are organized into five categories: Reduce Phosphorus Loadings; Ensure Effective Policies, Programs and Legislation; Improve the Knowledge Base; Educate and Build Awareness; and Strengthen Leadership and Coordination.

The key impact on the levels of treatment required for the Region of Waterloo WWTPs is that it is expected that point sources (which contribute 10% to 15% of total load to Lake Erie) will be required to meet a legal effluent discharge limit of 0.5 mg/L total phosphorus monthly average for all municipal WWTPs that have an average daily flow of 3,780 m³/d or more. The Draft Action Plan recognizes that these limits can be achieved using new technology retrofits and/or process modifications which can be made to existing secondary sewage treatment plants that can approach or match the effluent phosphorus concentrations attainable through conventional tertiary treatment (i.e., chemically-assisted filtration), but at a lower cost.

3.2.2.3 Phosphorus Trading

Plant specific effluent quality limits for total phosphorus are identified based on ACS and/or Lake Erie basin loading limits. Phosphorus trading involves shifting allowable loading between different plants in the same watershed. For this case, one plant would need to achieve a higher level of phosphorus removal to off-set lower removal at another facility. Overall, the net TP loading to the watershed remains unchanged or slightly improved. Phosphorus trading is generally considered to reduce infrastructure needs at one of the plants; however, there may be the potential to reduce infrastructure needs at more than one plant depending on the trading scenario considered.

A potential opportunity for phosphorus trading was identified for the Waterloo and Kitchener WWTPs to look at deferring or eliminating the need for tertiary treatment at the Waterloo WWTP.

3.2.2.4 Phosphorus Off-Setting

Phosphorus off-setting is a flexible watershed based program that ultimately improves and protects water quality in the rivers. It allows for a limited increase in phosphorus discharge to be “offset” by greater reductions elsewhere in the same watershed. The reduction is achieved through an offsetting ratio that is applied to the discharge. Phosphorus off-setting is often more economical than point-source control because more cost-effective controls can be constructed to achieve the required phosphorus reductions (LSRCA 2014).

Phosphorus off-setting can either occur as “one-offs” or as a formal Water Quality Trading (WQT) program. These are based on site-specific conditions for municipal and/or industrial WWTPs and are determined on a case-by-case basis. Water quality offsets can be explored as part of sewage treatment plant design or as part of the Class EA planning process (Tovilla, 2015).

Since the passing of the Lake Simcoe Protection Act in 2008, Section 75 of the Ontario Water Resources Act (OWRA) was amended to allow for WQT regulations to be made in Ontario (Water Resources Act, Section 75). This includes prescribing areas, parameters, and persons to which the regulation applies, the requirements for monitoring and reporting, designating an administrative body, and determining the creation, trading and retirement of credits or offsets. It is important to note that the

provision is not yet proclaimed and may be automatically repealed in 2018 if the proclamation is not issued (Legislation Act, 2006 Section 10.1 (2)).

Potential areas to focus phosphorus off-setting efforts are the Nith, Conestogo and Canagagigue Subwatersheds, areas of substantial soil loss/erosion as identified by GIS, digital elevation and soil erosion modelling, phosphorus offsets currently under the RWQP umbrella, and urban stormwater controls.

3.3 Receiving Water Considerations

The following sections provide a review of the available information to suggest realistic and appropriate future effluent objectives and make recommendations on level of treatment for the Region's treatment facilities. The goal is to ensure protection of the receiving water environment and be consistent with current and expected future regulatory trends.

3.3.1 Waterloo WWTP

The Waterloo WWTP is conventional activated sludge plant with an existing ECA approved hydraulic capacity of 72,730 m³/d and a rated average day (ADF) capacity of 57,500 m³/d. The treated water is discharged to the Grand River, a MOECC Policy 2 receiver for TP (GRCA 2011), which means that no further degradation of water quality will be allowed (MOECC, 1994). The plant is expected to expand to a minimum design ADF of approximately 63,600 m³/d based on the projected 2051 flows developed through the 2018 WWTMP Update.

An ACS was completed for the Grand River for the Waterloo WWTP in 2014. The ACS proposed an effluent TP objective of 0.2 mg/L with a calculated average daily loading of 14.6 kg/d at a design ADF of 72,730 m³/d, which is consistent with the ECA approved hydraulic capacity of the Waterloo WWTP (Stantec, 2014). The background data used for the ACS was based on the 2006-2011 Grand River quality data.

Following the completion of the ACS, the Waterloo WWTP has been undergoing upgrades to provide year-round nitrification. A portion of the upgrades to provide increased oxygenation capacity were completed in 2014, which allow the plant to achieve partial nitrification (mostly in the warmer summer months). The remainder of the upgrades have recently been completed and commissioned, which allow the plant to meet the year-round effluent objectives for total ammonia nitrogen (TAN) identified

in the ECA. The impacts of these upgrades on the river water quality will continue to be monitored and assessed through the Region's SWQMP.

A review of the water quality data (2014) from the SWQMP indicated that overall, the only statistically significant change in water quality in the vicinity of the Waterloo WWTP, is the positive impact of partial nitrification during warmer summer months. Accordingly, the 2014 ACS proposed TP treatment objectives and limits for the plant are still considered appropriate for the 2018 WWTMP Update.

Per MOECC Policy 2 requirements, to maintain the 2014 ACS allowable loadings of 14.6 kg/d at a reduced design flow of 63,600 m³/d (due to the lower than expected population growth rate in the plant service areas), the suggested future TP effluent objective would be 0.23 mg/L. This objective represents a significant reduction in TP concentrations and loadings to the receiving water compared to the current ECA.

Table 8 summarizes suggested effluent objectives for the Waterloo WWTP at a rated capacity of 63,600 m³/d. The suggested limits are consistent with levels associated with a conventional single-stage tertiary treatment facility with chemical dosing. These objectives will need to be confirmed as part of a Schedule C Class EA for a plant expansion.

Table 8 Waterloo WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	ACS Recommended Objectives at 73,200 m ³ /d	Suggested Effluent Objectives at 63,600 m ³ /d
cBOD ₅	10 mg/L	10 mg/L	10 mg/L
TSS	10 mg/L	10 mg/L	10 mg/L
Ammonia-Nitrogen	1.5 mg/L	1.5 mg/L	1.5 mg/L
TP	0.4 mg/L	0.2 mg/L	0.23 mg/L
<i>E. Coli</i>	100 cfu/100 mL	100 cfu/100 mL	100 cfu/100 mL

As part of the 2007 WWTMP and subsequent St Jacobs and Elmira WWTMP recommendations, a diversion of flows from the St Jacobs WWTP service area to the Waterloo WWTP was identified as an option that may be beneficial. It is important to note that if the St Jacobs WWTP flows were diverted to the Waterloo WWTP, the total future flow would be approximately 65,200 m³/d for the Waterloo WWTP. With the slightly higher future flow (approximately 2.5% increase), the suggested effluent TP objective would need to be reduced slightly from 0.23 mg/L to 0.22 mg/L to maintain

the 2014 ACS TP loading. As a result, the impact of the diversion of St Jacobs flow on the effluent TP objectives of the Waterloo WWTP is considered minor.

3.3.2 Preston WWTP

The Preston WWTP is a conventional activated sludge plant with an ECA rated capacity of 16,800 m³/d. The plant provides a high level of year-round nitrification and phosphorus removal through chemical addition, with treated water being discharged to the Grand River, a Policy 2 receiver for TP.

The Preston WWTP does not require an expansion within the planning period; therefore, no significant changes are expected for most effluent quality parameters. However, the 2017 Canada-Ontario Phosphorus Reductions Action Plan for Lake Erie, has proposed a legal effluent discharge limit of 0.5 mg/L total phosphorus monthly average for all municipal WWTPs in the Lake Erie basin that have an average daily flow of 3,780 m³/d (refer to Section 2.4). As a result, the Preston WWTP future TP effluent objective will be reduced to meet the Lake Erie targets (i.e. 0.5 mg/L).

For the purposes of this Master Plan, it was conservatively assumed the effluent TP concentration compliance limits would be 0.5 mg/L (consistent with Lake Erie recommendations), with an effluent objective concentration of 0.4 mg/L. Table 9 summarizes current and suggested future effluent objectives for the Preston WWTP.

Table 9 Preston WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	Suggested Effluent Objectives at 16,800 m ³ /d
cBOD ₅	10 mg/L	10 mg/L
TSS	10 mg/L	10 mg/L
Ammonia-Nitrogen		
May 1 – September 30	3 mg/L	3 mg/L
October 1 – April 30	5 mg/L	5 mg/L
TP	0.6 mg/L	0.4 mg/L
<i>E. Coli</i>	200 cfu/100 mL	200 cfu/100 mL

3.3.3 Hespeler WWTP

The Hespeler WWTP is an extended aeration plant with a current ECA rated capacity of 9,320 m³/d. The plant has been able to partially nitrify during warm months, with the treated water being discharged to the Speed River, a MOECC Policy 2 receiver for TP. The plant is expected to expand to a design ADF of approximately

10,400 m³/d based on the projected 2051 flows developed through the 2018 WWTMP Update.

An ACS was completed for the Hespeler WWTP in 2014. The ACS proposed an effluent TP objective of 0.4 mg/L with a calculated average daily loading of 5.3 kg/d at a 2051 design ADF of 13,200 m³/d based on the expected plant capacity identified in the 2007 WWTMP (Stantec, 2014). The background data used for the Hespeler WWTP ACS was based on the 2006-2011 Speed River quality data.

A review of the water quality data (2014) from the SWQMP indicated that there are minimal statistically significant changes in water quality in the vicinity of the Hespeler WWTP, with the exception of the positive impact of partial nitrification during warmer summer months.

Phosphorus removal is expected to be required as part of the plant expansion and the Lake Erie effluent phosphorus target requirements. However, the primary driver for the phosphorus removal for Hespeler WWTP will be the Lake Erie targets as this is expected to be required prior to the need for additional plant capacity. As a result, the future effluent TP objective is expected to be at 0.4 mg/L, based on the anticipated Lake Erie basin loading recommendations. Since the changes based on the Lake Erie targets will re-define the baseline conditions for the Policy 2 Speed River, an updated ACS will be required for expansion of the Hespeler WWTP.

Table 10 summarizes current and suggested future effluent objectives for the Hespeler WWTP. The future objectives are consistent with the performance of a secondary treatment facility with optimized chemical addition. These objectives will need to be confirmed through a new ACS to be completed during a Schedule C Class EA for the Hespeler WWTP expansion.

Table 10 Hespeler WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	Suggested Effluent Objectives at 10,400 m ³ /d
cBOD ₅	15 mg/L	10 mg/L
TSS	15 mg/L	10 mg/L
Ammonia-Nitrogen		
May 1 – November 30	N/A	2 mg/L
December 1 – April 30	N/A	5 mg/L
TP	0.75 mg/L	0.40 mg/L
<i>E. Coli</i>	150 cfu/100 mL	150 cfu/100 mL

3.3.4 Wellesley WWTP

The Wellesley WWTP is an extended aeration plant, with a rated ADF capacity of 1,100 m³/d. The treated water is discharged to the Nith River. The plant is expected to expand to a design ADF of approximately 1,320 m³/d based on the projected 2051 flows developed through the 2018 WWTMP Update. A recent ACS specific to the Wellesley WWTP is not available.

The Nith River is a Policy 2 receiver for TP, as background TP concentrations consistently exceed the PWQO of 0.03 mg/L (GRCA 2011). Previous studies identified the high level of background phosphorus concentrations in the Nith River watershed to be primarily from non-point sources (e.g. agricultural sources), compared to the relatively smaller loadings from point sources such as the Region's WWTPs (AECOM, 2011). As a result, WWTP discharge flows have a low impact on the water quality of the Nith River. However, per Policy 2 requirements, the TP loading of the plant effluent cannot be increased beyond the current ECA approved loading objectives (MOECC, 1994b).

Consistent with a Policy 2 receiver, an effluent TP objective of 0.42 mg/L is required to maintain the existing ECA allowable loadings of 0.55 kg/d at an expanded Wellesley WWTP capacity of 1,320 m³/d. The specific TP required objective will be determined as part of an ACS in support of the plant expansion.

Table 11 summarizes current and suggested future effluent objectives for the Wellesley WWTP. The suggested effluent TP objectives are consistent with the performance of an optimized single stage tertiary treatment facility. Effluent objectives will need to be confirmed through an ACS to be completed during a Schedule C Class EA for the Wellesley WWTP expansion.

Table 11 Wellesley WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	Suggested Effluent Objectives at 1,320 m ³ /d
cBOD ₅	10 mg/L	5 mg/L
TSS	10 mg/L	5 mg/L
Ammonia-Nitrogen	0.5 mg/L	0.35 mg/L ⁽¹⁾
TP	0.5 mg/L	0.42 mg/L
<i>E. Coli</i>	200 cfu/100 mL	100 cfu/100 mL

Notes:

1. Based on current requirements for the New Hamburg WWTP, as both the Wellesley and New Hamburg WWTPs discharge to the Nith River.

3.3.5 St Jacobs WWTP

The St Jacobs WWTP is an extended aeration plant, with a rated ADF capacity of 1,450 m³/d. The treated water is discharged to the Conestogo River, a MOECC Policy 2 receiver for TP. The plant is expected to expand to a design ADF of approximately 1,600 m³/d based on the projected 2051 flows developed through the 2018 WWTMP Update.

A Receiving Water Quality Impact Study (RWQIS) was completed for the Conestogo River in 2011. The study proposed an effluent TP objective of 0.15 mg/L, resulting in a daily loading of 0.32 kg/d at an expanded plant capacity of 2,100 m³/d (XCG, 2011).

Per Policy 2 requirements, to be conservative and to maintain the existing ECA allowable loading of 0.30 kg/d rather than the loading of 0.32 kg/d identified in the RWQIS at a future design ADF of 1,600 m³/d, the suggested future TP effluent objective would be 0.18 mg/L.

Table 12 summarizes current and suggested future effluent objectives for the St Jacobs WWTP. The suggested effluent objectives are based on the RWQIS recommendations with a slightly lower phosphorus concentration objective to maintain existing allowable effluent TP loadings. Overall, the suggested effluent objectives are consistent with the performance of an optimized single stage tertiary treatment facility. Effluent objectives will need to be confirmed through an ACS to be completed during a Schedule C Class EA for the St Jacobs WWTP expansion.

Table 12 St Jacobs WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	Suggested Effluent Objectives at 1,600 m ³ /d
cBOD ₅	5 mg/L	5 mg/L
TSS	5 mg/L	5 mg/L
Ammonia-Nitrogen May 1 – October 31 November 1 – September 30	0.7 mg/L 1.0 mg/L	0.5 mg/L 1.0 mg/L
TP	0.2 mg/L	0.18 mg/L
<i>E. Coli</i>	100 cfu/100 mL	100 cfu/100 mL

3.3.6 Elmira WWTP

The Elmira WWTP is a biological nutrient removal (BNR) plant, with a rated ADF capacity of 7,800 m³/d. The treated water is discharged to the Canagagigue Creek, a MOECC Policy 2 receiver for TP. The plant is required to expand to a design ADF of approximately 10,000 m³/d based on the projected 2051 flows developed through the 2018 WWTMP Update. A recent ACS specific to the Elmira WWTP is not available.

Per Policy 2 requirements, to maintain the current ECA approved loading of 1.56 kg/d at a future design ADF of 10,000 m³/d, the suggested future TP effluent objective would be 0.15 mg/L. The specific TP required objective will need to be determined as part of an ACS in support of the plant expansion.

Table 13 summarizes current and suggested future effluent objectives for the Elmira WWTP. Overall, the suggested effluent objectives are consistent with the performance of an optimized single stage tertiary treatment facility. Effluent objectives will need to be confirmed through an ACS to be completed during a Schedule C Class EA for the Elmira WWTP expansion.

Table 13 Elmira WWTP Current and Future Planning Effluent Objectives

Parameter	Existing ECA Objectives	Suggested Effluent Objectives at 10,000 m ³ /d
cBOD ₅	5 mg/L	5 mg/L
TSS	5 mg/L	5 mg/L
Ammonia-Nitrogen		
May 1 – October 31	0.4 mg/L	0.4 mg/L
November 1 – September 30	1.0 mg/L	1.0 mg/L
TP	0.2 mg/L	0.15 mg/L
<i>E. Coli</i>	-	100 cfu/100 mL

3.4 Summary of Expected Level of Treatment

A summary of suggested effluent objectives and anticipated level of treatment is provided in Table 14.

Table 14 Suggested Effluent Objectives and Anticipated Level of Treatment

WWTP	Future CBOD ₅ Objective (mg/L)	Future TSS Objective (mg/L)	Future Ammonia-N Objective (mg/L)	<i>E. coli</i> (cfu/100 mL)	Suggested Future TP Treatment Objectives		Required Level of Treatment
					Conc. (mg/L)	Loading (kg/d)	
Waterloo	No Change from Existing	No Change from Existing	No Change from Existing	No Change from Existing	0.23	14.6	Tertiary filtration
Preston	No Change from Existing	No Change from Existing	No Change from Existing	No Change from Existing	0.40	6.7	Secondary treatment with chemical phosphorus removal
Hespeler	10	10	2 (non-freezing) ⁽¹⁾ 5 (freezing) ⁽²⁾	No Change from Existing	0.40	4.2	Secondary treatment with chemical phosphorus removal
Wellesley	5	5	0.35	100	0.42	0.55	Tertiary filtration
St Jacobs	No Change from Existing	No Change from Existing	0.5 (non- freezing) ⁽¹⁾ 1.0 (freezing) ⁽²⁾	No Change from Existing	0.18	0.30	Tertiary filtration
Elmira	No Change from Existing	No Change from Existing	No Change from Existing	100	0.15	1.56	Tertiary filtration

Notes:

1. Non-freezing: May 1 to October 31
2. Freezing: November 1 to September 30.
3. Galt WWTP will require an update to the ECA based on anticipated Lake Erie targets; however, no upgrades are required to meet the required level of treatment (tertiary filters already installed).
4. No changes to level of treatment are expected for the Kitchener, Ayr, New Hamburg, Conestogo, Foxboro, Alt-Heidelberg WWTPs as expansions are not required within the planning horizon, and upgrades are not expected based on anticipated Lake Erie targets (i.e. plants are either already achieving anticipated Lake Erie targets or the average day rated capacity is less than 3,780 m³/d).

4. Status of Existing Facilities

This section provides a review of the existing conditions, historical performance, and capacity review of major unit processes for each WWTP. The purpose is to identify current and future needs at each WWTP. Additional details are available in TM2 – Status of Existing Treatment Facilities and Capacity Assessment, in Appendix C.

4.1 Kitchener WWTP

The Kitchener WWTP is a conventional activated sludge plant that provides treatment for wastewater generated in the City of Kitchener. The WWTP is comprised of two separate secondary treatment plants (Plants 1 and 2) served by common headworks and primary clarifier facilities. Plant 1 was constructed in the 1960s and Plant 2 was constructed in the 1970s. The plant is currently operated under MOECC ECA No. 0102-9RDM5C issued on February 4, 2015. The Kitchener WWTP has a rated average day flow (ADF) capacity of 122,745 m³/d and a peak flow capacity of 306,862 m³/d.

The existing treatment processes include screening, grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Ferric chloride is added upstream of the primary clarifiers and ferrous chloride is added downstream of the primary clarifiers, before the flow is split between Plants 1 and 2. Co-thickened waste activated sludge (WAS) and raw sludge is anaerobically digested, dewatered via centrifuges at the nearby Manitou Drive Biosolids Dewatering Facility, with biosolids beneficially used when possible in agriculture or in the remediation of mine tailing ponds in Ontario. As a contingency, biosolids are sent to landfill when use in agriculture and mine remediation is not possible. Centrate from Manitou Drive is returned to Plant 2 for treatment. The plant also receives aerated sludge from the Hespeler WWTP for processing through the liquid treatment train.

The Kitchener WWTP has recently completed Phase 1 and Phase 2 upgrades and is in the process of Phase 3 upgrades. These upgrades include:

- ✦ Phase 1: Construction of the Manitou Drive Wastewater Residuals Management Centre (WWRMC) for biosolids dewatering.

- ✦ Phase 2: Upgrades to the Plant 2 aeration tanks to enhance ammonia removal and construction of a new UV disinfection and effluent pumping station facility.
- ✦ Phase 3: Upgrades to replace equipment that was reaching the end of its useful life and to enhance effluent quality with year-round nitrification and tertiary filtration. This includes new headworks, new secondary treatment plants (Plants 3 and 4; to replace existing Plant 1), tertiary filtration, and anaerobic digestion upgrades. The rated capacity of the plant will remain 122,745 m³/d.

In addition, the Region is in the process of assessing the recommended timing for a new administration building, separate WAS thickening and miscellaneous works at the Kitchener WWTP.

4.1.1 Flow

Table 15 summarizes historic flows to the Kitchener WWTP over the period from 2012 to 2014. At the Kitchener WWTP, the average raw wastewater flow for the review period was 70,970 m³/d, or approximately 60% of the rated capacity of 122,745 m³/d. The average per capita flow was 300 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The peak raw wastewater flow between 2012 and 2014 was 147,370 m³/d, or approximately 48% of the peak flow capacity of 306,862 m³/d.

Table 15 Historic Flow to the Kitchener WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	122,745	-
Rated Peak Flow Rate (m ³ /d)	306,860	-
ADF (m ³ /d)	70,970 (60%)	-
PDF (m ³ /d)	147,370	2.1 ⁽¹⁾
PHF (99.9 th percentile) (m ³ /d)	170,320	2.4 ⁽²⁾
PIF (m ³ /d)	248,380	3.5 ⁽³⁾
Average Per Capita Flow (L/cap·d)	300 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (April 2013 to December 2014).
3. Based on the Kitchener WWTP Phase 3 Upgrades Preliminary Design Report (AECOM, August 2012).
4. Based on ADF of 70,970 m³/d and a 2014 population of 234,466 provided in the Region's 2015 WWWMR.

4.1.2 Effluent Limits

The Kitchener WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits with respect to CBOD₅, TSS, TP and TAN for the majority of the historic review period (2012 – 2014). The exception was a few occasions where the effluent monthly average TP concentrations exceeded the ECA non-compliance limits (August 2012, May 2013, July 2013, October 2013, and November 2013) due to an upset condition during the Plant 2 aeration system upgrade construction and commissioning. The on-going Phase 3 upgrades address the previous TP upsets with improved settling characteristics in secondary treatment and implementation of tertiary filtration.

With the completion of Phase 2 upgrades, there has already been a significant improvement in effluent quality, particularly in terms of ammonia. With the completion of the secondary treatment upgrades including year-round nitrification as part of the Phase 3 upgrades, the plant is expected to achieve further improved effluent quality.

Following completion of Plants 3 & 4 and the tertiary treatment facility, a more stringent effluent limit for phosphorus and year-round nitrification as identified in the most recent ECA will become effective. No other changes to effluent limits are expected within the planning period.

4.1.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The unit process capacity review was based on the Phase 3 upgraded plant (i.e. Plants 2, 3, and 4 are in service), as the Phase 3 upgrades are nearing completion. In addition, as mentioned previously, the Region is in the process of planning Phase 4 upgrades, which will include separate WAS thickening. As a result, for the purpose of this review, both WAS co-thickening and separate WAS thickening were considered. Figure 4 summarizes the unit process capacities at the Kitchener WWTP.

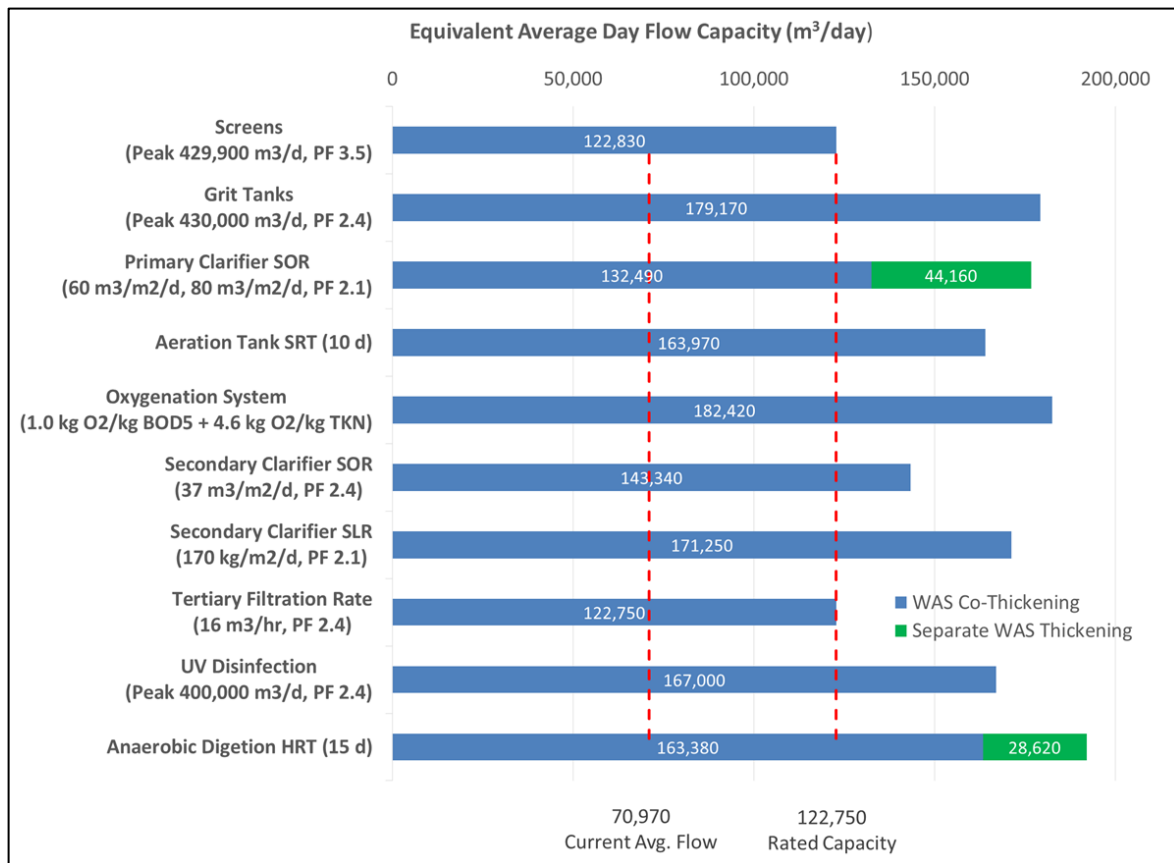


Figure 4 Kitchener WWTP Unit Process Capacity Summary

All of the unit processes at the Kitchener WWTP have sufficient capacity to meet the design flow of 122,745 m³/d upon the completion of the Phase 3 upgrades. It is noted that the capacity of the primary clarifiers and anaerobic digesters will be increased with separate WAS thickening.

4.1.4 Status of 2007 WWTMP Projects

The short-term and mid-term projects for the Kitchener WWTP recommended in the 2007 WWTMP are either complete or nearing completion, including:

- + Upgrades to existing Plant 2 to provide nitrification and plug-flow treatment.
- + Digestion and dewatering upgrades.
- + New UV disinfection and effluent pumping station
- + Construction of a third process train (Plants 3 and 4) to replace Plant 1 and restore rated capacity to 122,745 m³/d with full nitrification.

- ✦ Construction of a tertiary treatment facility and a new outfall to the Grand River.

The long-term expansion to 140,000 m³/d (as identified in the 2007 WWTMP) is being re-evaluated as part of this Master Plan update.

4.1.5 Future Opportunities/Constraints

Following the ongoing upgrades, the Kitchener WWTP will provide full nitrification and tertiary treatment for the existing rated capacity of 122,745 m³/d. Based on the extent of recent and on-going upgrades, the Kitchener WWTP is a newly upgraded plant in good overall condition. This capacity is sufficient to service the planned growth to 2051, including the ESL.

4.2 Waterloo WWTP

The Waterloo WWTP is a conventional activated sludge plant that provides treatment for wastewater generated in the City of Waterloo and a small portion from the City of Kitchener. The plant is currently operated under MOECC ECA No. 9354-8J4PUE issued on January 25, 2012. The plant has an existing ECA approved hydraulic capacity of 72,730 m³/d, with a rated ADF capacity of 57,500 m³/d and a peak flow capacity of 138,000 m³/d. The Region has recently completed upgrades that provide full year-round nitrification at the 57,500 m³/d capacity.

The existing treatment processes include screening, grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Ferric sulfate is added prior to the primary clarifiers and/or aeration tanks for phosphorus removal. Raw sludge and mechanically thickened WAS are anaerobically digested, and dewatered via centrifuges, with biosolids beneficially used when possible in agriculture or in the remediation of mine tailing ponds in northern Ontario. As a contingency, biosolids are sent to landfill when use in agriculture and mine remediation is not possible. Centrate from the dewatering centrifuges is returned to the liquid treatment train.

4.2.1 Flow

Table 16 summarizes historic flows to the Waterloo WWTP over the period from 2012 to 2014. The average raw wastewater flow during this review period was 46,640 m³/d, or approximately 80% of the rated capacity. The average per capita flow was 340 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic

sewage (MOECC, 2008). The peak raw wastewater flow between 2012 and 2014 was 116,600 m³/d, or approximately 84% of the peak flow capacity of 138,000 m³/d.

Table 16 Historic Flow to the Waterloo WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	57,500	-
Rated Peak Flow Rate (m ³ /d)	138,000	-
ADF (m ³ /d)	46,640 (80%)	-
PDF (m ³ /d)	116,580	2.4 ⁽¹⁾
PHF (m ³ /d)	125,920	2.7 ⁽²⁾
PIF (m ³ /d)	158,560	3.4 ⁽³⁾
Average Per Capita Flow (L/cap·d)	340 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 20% of ADF to account for diurnal conditions.
3. Based on Waterloo Wastewater Treatment Plant Design Brief (AECOM, May 2011).
4. Based on ADF of 46,640 m³/d and a 2014 population of 136,179 provided in the Region's 2015 WWWWMR.

4.2.2 Effluent Limits

The Waterloo WWTP has historically produced good quality effluent that has met the MOECC ECA effluent compliance limits during the review period (2012-2014). At the time of the review period, the ECA did not include a total ammonia limit and the plant was able to achieve partial nitrification. Following the completion of the on-going upgrades, the Waterloo WWTP will provide year-round nitrification for the current rated capacity of the plant.

The Waterloo WWTP is expected to have changes to current effluent quality limits with any future expansion. An ACS was completed for the Waterloo WWTP in 2014. The suggested effluent objectives for the Waterloo WWTP have been identified in Section 3.3.1 of this report. Overall, the suggested limits are consistent with performance achievable with a conventional single-stage tertiary treatment facility with chemical dosing. These objectives will need to be confirmed as part of a Class EA for a plant expansion.

4.2.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. The unit process capacity reviewed for the Waterloo WWTP includes the current upgrades (to provide full year-round nitrification for a rated capacity of 57,500 m³/day), which are nearing completion. Figure 5 summarizes the unit process capacities at the Waterloo WWTP.

The main findings and recommendations are summarized below:

- ✦ All the treatment processes at the Waterloo WWTP are sized sufficiently for the rated capacity of 57,500 m³/d, with the implementation of the current upgrades. Some treatment processes were strategically oversized during these upgrades to accommodate the maximum hydraulic capacity of 72,730 m³/d ADF.
- ✦ Anaerobic digesters are sufficient for the plant design flow, with the increased capacity due to separate WAS thickening and the retrofit of the existing secondary digester to operate as either primary or secondary digester.

Overall, the Waterloo WWTP has an available equivalent ADF capacity of 57,500 m³/d.

4.2.4 Status of 2007 WWTMP Projects

The Phase 1 capacity expansion recommended in the 2007 WWTMP is near completion, providing the Waterloo WWTP with an installed treatment capacity of 57,500 m³/d, full year-round nitrification and flexibility to increase capacity of all unit processes to 72,730 m³/d (AECOM, May 2011).

4.2.5 Future Opportunities/Constraints

The next phase expansion is currently included in the Region's capital budget for construction starting 2020, with an allowance for tertiary treatment to meet lower TP effluent limits. The timing and requirements for this expansion will be confirmed as part of this Master Plan based on up-to-date forecasts for growth and flow projections.

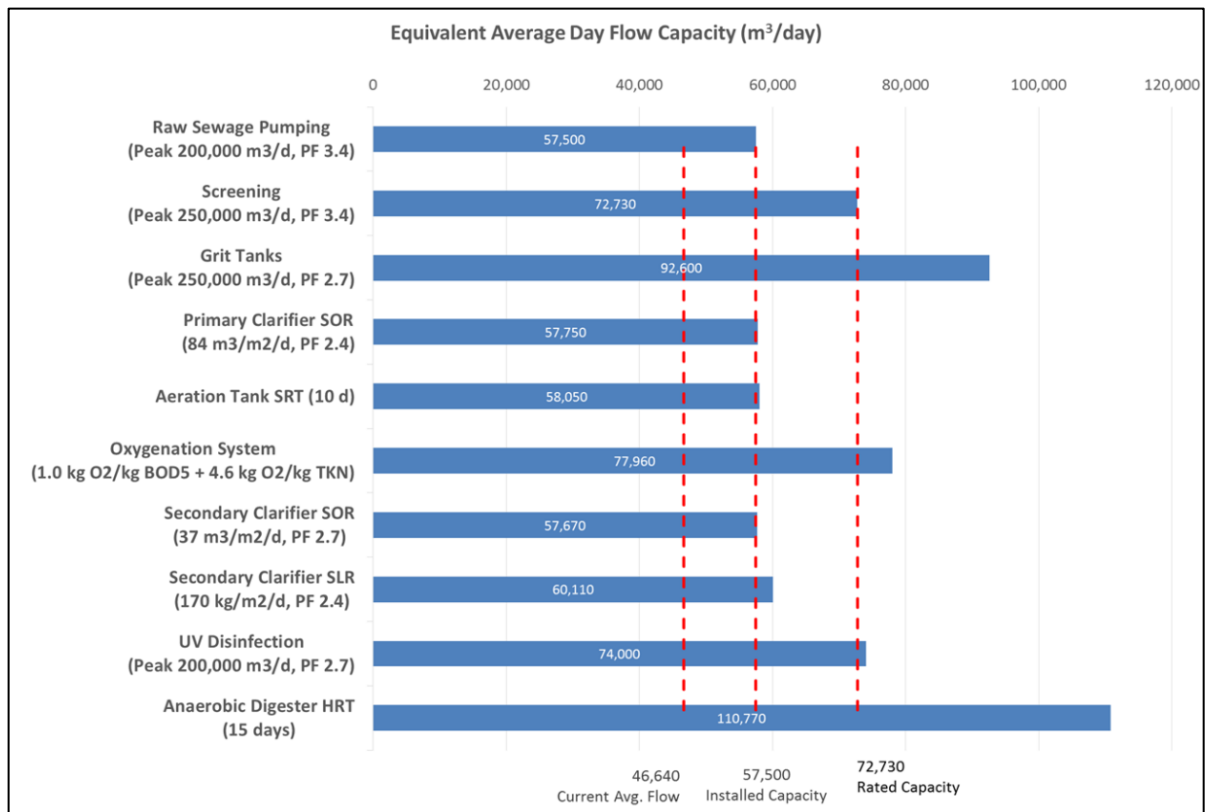


Figure 5 Waterloo WWTP Unit Process Capacity Summary

4.3 Galt WWTP

The Galt WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The plant is operated under MOECC ECA No. 2567-8ZEHYF issued on January 14, 2013. The plant has an existing ECA approved Stage 1 rated ADF flow capacity of 56,800 m³/d and a peak flow of 171,100 m³/d.

The existing treatment processes include screening, aerated grit removal, primary clarification, aeration, secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Grand River. Ferric chloride is added to aeration tank effluent channels and upstream of the primary clarifiers for phosphorus removal. Raw sludge and mechanically thickened WAS are anaerobically digested, and dewatered via centrifuges, with biosolids beneficially used when possible in agriculture or in the remediation of mine tailing ponds in northern Ontario. As a contingency, biosolids are sent to landfill when use in agriculture and mine remediation is not possible. Centrate from the dewatering centrifuges is returned to the liquid treatment train. The plant

also receives anaerobically digested biosolids from the Preston WWTP for dewatering and aerated sludge from the Hespeler WWTP for processing through the liquid treatment train.

4.3.1 Flow

Table 17 summarizes historic average flows to the Galt WWTP over the period from 2012 to 2014. The average raw wastewater flow during the review period was 35,230 m³/d, or approximately 60% of the Stage 1 rated capacity of 56,800 m³/d. The average per capita flow was 415 L/cap·d, which is at the higher end of the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). This may be attributed to the significant industrial contributions from the Industrial Road Service Area (IRSA), which was diverted from the Preston WWTP to the Galt WWTP in 2012 in order to release the capacity at the Preston WWTP. The peak day raw wastewater flow between 2012 and 2014 was 57,600 m³/d, or approximately 34% of the peak flow capacity of 171,100 m³/d.

Table 17 Historic Flow to the Galt WWTP (April 2012 – December 2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	56,800	-
Rated Peak Flow Rate (m ³ /d)	171,000	-
ADF (m ³ /d)	35,230 (60%)	-
PDF (m ³ /d)	57,600	1.6 ⁽¹⁾
PHF (m ³ /d) (99.9 th Percentile)	70,460	2.0 ⁽²⁾
PIF (m ³ /d)	105,680	3.0 ⁽³⁾
Average Per Capita Flow (L/cap·d)	415 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (January 2012 to December 2014).
3. Based on the Galt WWTP Facility Plan (CIMA, October 2016).
4. Based on ADF of 35,230 m³/d and a 2014 population of 85,088 provided in the Region's 2015 WWWMR.

4.3.2 Effluent Limits

The Galt WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits during the historic review period (2012-2014). All annual average loadings are within the ECA objectives and non-compliance limits with respect to CBOD₅, TSS, and TP.

The Galt WWTP has sufficient capacity for the Stage 1 capacity of 56,800 m³/d, with the exception of tertiary filtration and anaerobic digestion. The existing tertiary filters are overloaded at current flows and bypass routinely during peak flows, though tertiary filtration is not required to achieve plant effluent limits based on plant performance and the current plant ECA. The existing tertiary filters will be replaced with disk cloth filters as part of the plant planned upgrades according to the Galt WWTP Facility Plan (CIMA, 2017).

The Galt WWTP has adequate capacity for the planning period to 2051 and provides a high level of year-round nitrification and tertiary treatment. The plant is already meeting the proposed Lake Erie phosphorus targets (0.5 mg/L), although the current effluent TP objective (1.0 mg/L) is higher than this based on the current ECA limits. An update to the ECA is expected to be required in the planning period, consistent with the Lake Erie phosphorus targets.

4.3.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. In addition, recommendations of the Galt WWTP Facility Plan were used for the review of the unit processes, as these upgrades (e.g. including the existing tertiary filters upgrades) are scheduled for completion within the next 5 years. Figure 6 summarizes the unit process capacities at the Galt WWTP.

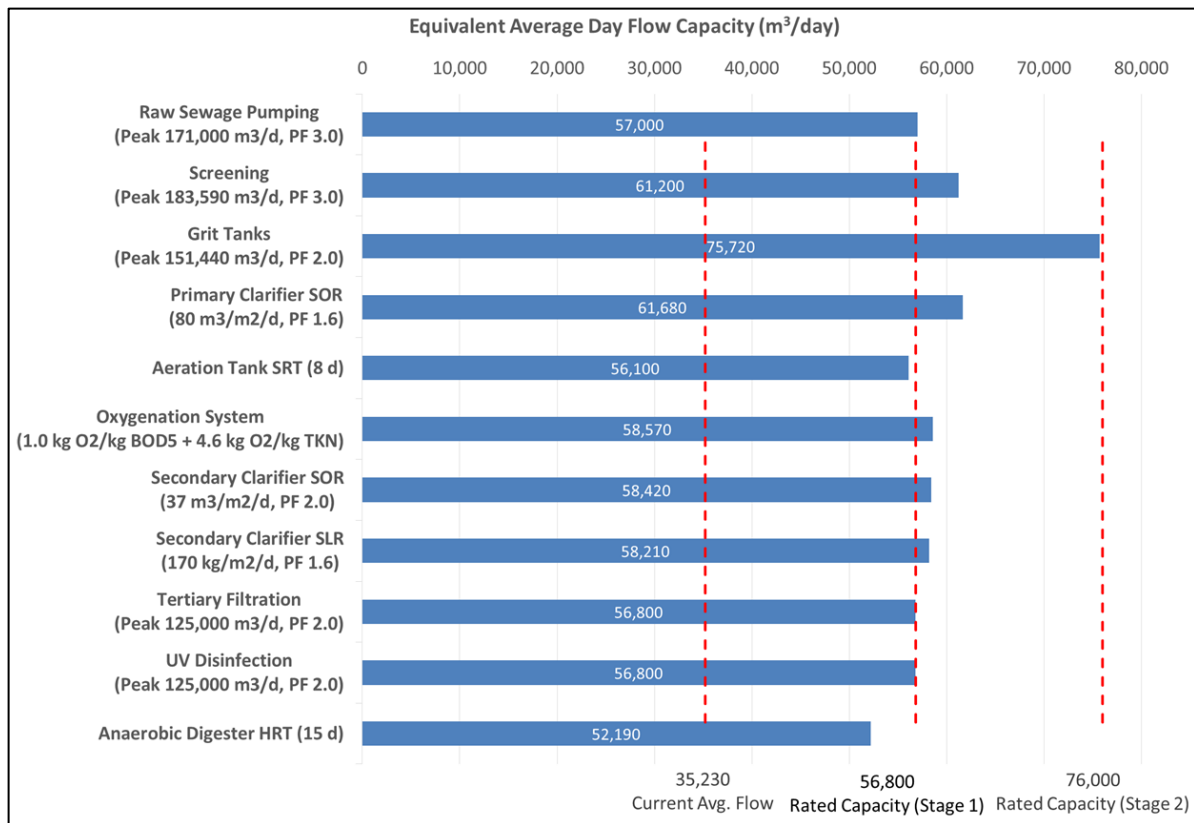


Figure 6 Galt WWTP Unit Process Capacity Summary

Overall, all of the treatment processes at the Galt WWTP are sized sufficiently for Stage 1 capacity. Digester capacity is borderline for Stage 1 capacity. More details are summarized below:

- ✦ Mechanical bar screens are sufficient for Stage 1 capacity; however there is no firm capacity or plant bypass.
- ✦ Overall the primary clarifier capacity of the existing plant is sufficient for Stage 1 capacity, however, based on the current flow split of approximately 50:50 between Plants A and B, the Plant B primary clarifier is overloaded at Stage 1 capacity. This could be addressed by adding an additional Plant B primary clarifier (CIMA, 2017).
- ✦ The aeration tank capacity is close to that required for Stage 1 capacity at 8.0 days SRT and 3,500 mg/L MLSS, with the increased capacity due to implementation of centrate equalization coupled with the dual point ferric sulfate

dosing for phosphorus removal. This increased capacity has been taken into consideration in the unit process capacity summary as shown in Figure 6.

- + The oxygenation system is sized sufficiently for Stage 1 capacity.
- + Overall the secondary clarifier capacity is sufficient for Stage 1 capacity.
- + Tertiary filters will have sufficient capacity to handle the Stage 1 capacity, upon the completion of the currently planned upgrades.
- + The existing anaerobic digester capacity is slightly lower than the Stage 1 rated capacity of 56,800 m³/d.

The Region is currently completing Contract 1 Upgrades and is planning Contract 2 Upgrades, which will address a number of these deficiencies. These upgrades include:

- + Contract 1 Upgrades
 - Headworks refurbishment and new screen bypass channel,
 - Primary influent flow splitting modification,
 - Odour control,
 - Plant B aeration tank diffuser replacement,
 - Tertiary and UV system upgrades, and
 - Miscellaneous: stormwater modifications to grit and filter buildings
- + Contract 2 Upgrades
 - Raw sewage pumping station refurbishment,
 - New Plant B primary clarifier,
 - Existing Plant B primary clarifier mechanism and primary sludge pump replacement,
 - New blowers for aeration tanks, existing Plant A secondary clarifier mechanism replacement,
 - Plant A primary clarifier equalization storage upgrades,

- Miscellaneous: stormwater modifications to raw SPS, administration, and blower buildings.

Once these two contracts are complete, the plant will have the full rated capacity of 56,800 m³/d available, with the exception of the digester capacity.

4.3.4 Status of 2007 WWTMP Projects

The Region has completed or is nearing completion of the short-term and mid-term recommendations for the Galt WWTP including:

- + Diversion of the IRSA to the Galt WWTP for treatment
- + Upgrades to secondary clarifiers and tertiary filters

The long-term expansion beyond 56,800 m³/d (as identified in the 2007 WWTMP) is being re-evaluated as part of this Master Plan update.

4.3.5 Future Opportunities/Constraints

With the completion of the planned upgrades, the Galt WWTP will have sufficient installed capacity for 56,800 m³/d, with the exception of the digestion capacity. In order to address the digestion capacity constraint, operational changes (i.e. operate at a HRT of approximately 14 days, and/or optimize transfers of sludge from other WWTPs to free up capacity at Galt) may be sufficient to provide the small digestion capacity increase required to 2051. This could be achieved through recommendations of the Region's Biosolids Master Plan and works at other facilities to optimize the loadings to the Galt WWTP. If operational changes are not able to achieve the needed capacity, options such as thermal hydrolysis or temperature phased anaerobic digestion (TPAD) could be considered as part of future capital projects. More details are available in TM7 – Identification and Screening of Alternative Solids Treatment Options in Appendix H.

Some space is available for future expansion at the Galt WWTP. However, based on growth projections, this will not be required until beyond 2051.

4.4 Preston WWTP

The Preston WWTP is a conventional activated sludge plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The plant is currently operated under MOECC ECA No. 2526-96VJBA issued on June 27, 2013.

The plant has a rated ADF capacity of 16,860 m³/d and a peak flow capacity of 43,300 m³/d.

The existing unit treatment processes include screening, vortex grit removal, primary clarification, aeration, secondary clarification and UV disinfection prior to discharge to the Grand River. Alum is added at the outlet of the aeration tanks for phosphorus removal. Co-thickened WAS and raw sludge is anaerobically digested and hauled for dewatering at the Galt WWTP.

4.4.1 Flow

Table 18 summarizes the historic flows to the Preston WWTP over the period from 2012 to 2014. The Preston WWTP average raw wastewater flow during the review period was 9,000 m³/d, or approximately 53% of the rated capacity of 16,860 m³/d. The average per capita flow was 440 L/cap·d, which is at the upper limit of the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). This may be attributed to the industrial contributions within the service area. The peak raw wastewater flow between 2012 and 2014 was 15,000 m³/d, or approximately 35% of the peak flow capacity of 43,300 m³/d.

It is important to note that flow from the IRSA, which is high in organic loading, had previously been directed to the Preston WWTP and limited the capacity of the plant. To release the capacity at the Preston WWTP, flow from the IRSA was diverted from the Preston WWTP to the Galt WWTP by the end of 2011. With the diversion of these flows, the rated capacity of the Preston WWTP is no longer restricted by the organic loadings of the industrial discharges.

Table 18 Historic Flow to the Preston WWTP (April 2012-December 2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	16,860	-
Rated Peak Flow Rate (m ³ /d)	43,300	-
ADF (m ³ /d)	9,000 (53%)	-
PDF (m ³ /d)	15,000	1.6 ⁽¹⁾
PHF (m ³ /d) (99.9 th Percentile)	19,000	2.1 ⁽²⁾
PIF (m ³ /d)	26,890	2.9 ⁽³⁾
Average Per Capita Flow (L/cap·d)	440 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on historic data (January 2012 to December 2014).
3. Assumed based on ECA peaking factor.
4. Based on ADF of 9,000 m³/d and a 2014 population of 20,656 provided in the Region's 2015 WWMR.

4.4.2 Effluent Limits

Based on the historical plant effluent quality, the Preston WWTP has been able to achieve its effluent compliance limits during the historic review period (2012 – 2014). The Preston WWTP doesn't require an expansion within the planning period; therefore, changes to most effluent quality parameters are not expected. However, as mentioned in Section 3.3.2, the Preston WWTP is expected to be required to meet a Lake Erie effluent TP discharge limit of 0.5 mg/L based on the Draft Action Plan. As a result, it is expected that the Preston WWTP future TP effluent objective will be reduced to meet the Lake Erie targets with an effluent TP concentration compliance limit of 0.5 mg/L (consistent with Lake Erie recommendations) and an effluent objective concentration of 0.4 mg/L.

A review of the existing treatment process at the Preston WWTP indicates the plant is already routinely achieving the expected TP objective of 0.4 mg/L. As the proposed effluent TP objectives are already being achieved, only minor work is anticipated to confirm objectives can be reliably achieved.

4.4.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved

ECA capacities, and typical design guidelines. Figure 7 summarizes the unit process capacities at the Preston WWTP. All treatment processes at the Preston WWTP are sized sufficiently for the current flows and plant rated capacity of 16,860 m³/d.

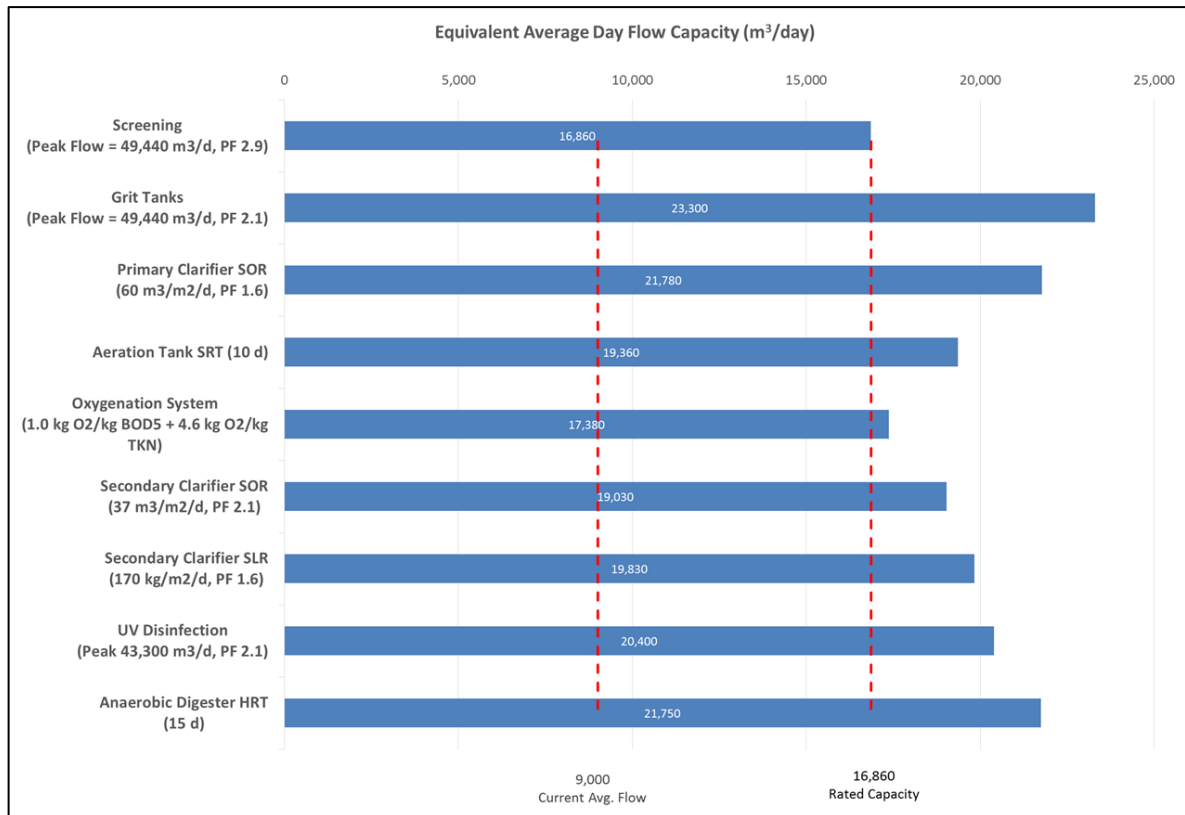


Figure 7 Preston WWTP Unit Process Capacity Summary

4.4.4 Status of 2007 WWTMP Projects

The Region has completed or is nearing completion of the short-term and mid-term recommendations for the Preston WWTP including:

- + Diversion of the IRSA to the Galt WWTP for treatment
- + Digestion upgrades
- + Dewatering of Preston WWTP biosolids at the Galt WWTP.

4.4.5 Future Opportunities/Constraints

The Preston WWTP has sufficient capacity to handle 2051 flows without expansion. With the plant currently only operating at 53% of the rated capacity, there is opportunity treat flows from the ESL in the interim at the Preston WWTP and defer

infrastructure costs for treating ESL flows at the Kitchener WWTP (refer to Section 5.2 for details).

4.5 Hespeler WWTP

The Hespeler WWTP is an extended aeration plant that provides treatment for wastewater generated from a portion of the City of Cambridge. The plant is currently operated under MOECC ECA No. 5631-7YZMCQ issued on January 22, 2010, with a rated ADF capacity of 9,320 m³/d and a peak flow capacity of 19,850 m³/d.

The existing unit treatment processes include aerated grit removal, aeration, secondary clarification, sodium hypochlorite disinfection and dechlorination prior to discharge to the Speed River. Alum is added prior to the secondary clarifiers for phosphorus removal. Waste activated sludge is sent to an aerated sludge holding tank where it is gravity thickened and trucked to the Kitchener or Galt WWTP for further treatment.

4.5.1 Flow

Table 19 summarizes historic flows to the Hespeler WWTP over the period from 2012 to 2014. The Hespeler WWTP average raw wastewater flow during the review period was 6,940 m³/d, or approximately 75% of the rated capacity of 9,320 m³/d. The average per capita flow was 270 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The peak raw wastewater flow was 12,300 m³/d, or approximately 62% of the peak flow capacity of 19,850 m³/d.

Table 19 Historic Flow to the Hespeler WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	9,320	-
Rated Peak Flow Rate (m ³ /d)	19,850	-
ADF (m ³ /d)	6,940 (75%)	
PDF (m ³ /d)	12,300	1.8 ⁽¹⁾
PHF (m ³ /d)	20,810	3.0 ⁽²⁾
PIF (m ³ /d)	23,590	3.4 ⁽²⁾
Average Per Capita Flow (L/cap·d)	270 ⁽³⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on Facility Assessment Study report (Stantec, June 2015).
3. Based on ADF of 6,940 m³/d and 2014 population of 25,737 provided in the Region's 2015 WWMR.

4.5.2 Effluent Limits

Based on the historical plant effluent quality, the Hespeler WWTP has met the MOECC ECA effluent limits for the historic review period (2012 – 2014), with the exception of the TP monthly average concentration that exceeded the ECA compliance limit in November 2013 due to an upset condition at the plant. This upset was rectified by the operational staff by adjusting MLSS, chemical dosage rates, and re-seeding the plant with mixed liquor from a well-established facility.

There are no total ammonia objectives or limits in the existing ECA, however, the plant has historically achieved partial nitrification.

The Hespeler WWTP discharges treated effluent to the Speed River. An ACS was completed in 2014 to recommend effluent limits for the Hespeler WWTP, however, as described in Section 3.3.3, an updated ACS will be required to account for the re-defined baseline conditions as a result of the Lake Erie targets. Future effluent targets, discussed in Section 3.3.3 are consistent with the performance of a secondary treatment facility with optimized chemical addition.

4.5.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved

ECA capacities, and typical design guidelines. It should be noted the capacity review was carried out for the upgraded Hespeler WWTP, as these upgrades are nearing completion. Figure 8 summarizes the unit process capacities at the Hespeler WWTP.

All the treatment processes have sufficient capacity for the design flow, upon the completion of the currently planned upgrades. It should be noted that the aeration tank capacity was based on a hydraulic retention time (HRT) of six (6) hours, assuming no nitrification requirements, consistent with the existing ECA. To achieve nitrification at the design capacity, additional aeration tankage or a newer innovative technology could be implemented.

Overall the plant will have an available equivalent ADF capacity of 9,470 m³/d, upon the completion of the planned upgrades.

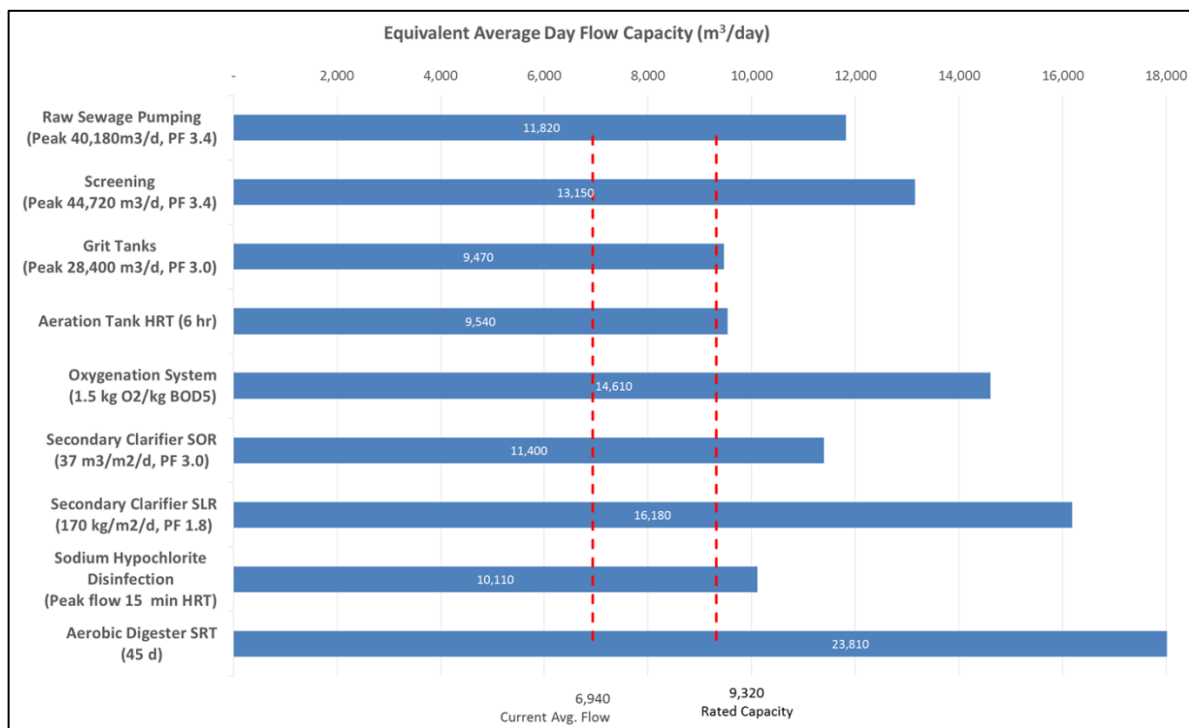


Figure 8 Hespeler WWTP Unit Process Capacity Summary

4.5.4 Status of 2007 WWTMP Projects

The Region is nearing completion of the short-term and mid-term recommendations (Phase 1) for the Hespeler WWTP including:

- + Construction of influent pump station

- ✦ Upgrades to headworks, aeration and aerobic digestion.

The Phase 2 upgrades to achieve nitrification for the rated design capacity are planned based on an alternative process using Membrane Aerated Biofilm Reactor (MABR) and will follow the completion of the Phase 1 upgrades. The long-term expansion of the Hespeler WWTP (as identified in the 2007 WWTMP) is being re-evaluated as part of this Master Plan update.

4.5.5 Future Opportunities/Constraints

A Facility Assessment has recently been completed for the plant to identify facilities that require improvements before the next planned expansion (Stantec, 2015). The recommended upgrades currently being completed include the design and construction of a new fine screening and grit removal facility, new air blowers, addition of a third secondary clarifier, and a new WAS thickening facility. These upgrades have been included in the Region's capital budget for the 2018-2020 construction.

Based on the potential deferral for a capacity expansion, as identified in this 2018 WWTMP Update, it is expected that mid-term upgrades will also be required to nitrify as per the ACS conducted in 2014, with a proposed ECA objective of 2 and 5 mg/L for $\text{NH}_3\text{-N}$ (summer and winter, respectively). An updated ACS is expected to be required to confirm proposed effluent criteria for the expanded plant, as discussed in Section 3.3.3.

Optimization of chemical precipitation to achieve a proposed TP effluent objective of 0.4 mg/L will also be required for the Hespeler WWTP. A reduction in effluent TP concentration is required by both the Lake Erie target and assimilative capacity, however, the primary driver is considered to be the Lake Erie target as that is expected to come into effect prior to the need for additional capacity.

4.6 St Jacobs WWTP

The St Jacobs WWTP is an oxidation ditch extended aeration plant that provides treatment for wastewater generated in the Town of St Jacobs located in the Township of Woolwich. The plant is operated under MOECC ECA No. 1047-94FHWA issued on March 22, 2013. The St Jacobs WWTP has a rated ADF capacity of 1,450 m³/d and a peak flow capacity of 5,180 m³/d.

The existing unit treatment processes include screening, vortex grit removal, aeration, secondary clarification, tertiary filtration and UV disinfection prior to

discharge to the Conestogo River. Alum is added both upstream and downstream of the secondary clarifiers for phosphorus removal. Waste activated sludge is stored in an aerated sludge holding tank prior to being hauled to the Waterloo WWTP for further processing.

4.6.1 Flow

Table 20 summarizes the historic flow to the St Jacobs WWTP over the period from 2012 to 2014. The average raw wastewater flow during this review period was 920 m³/d, or approximately 65% of the rated capacity of 1,450 m³/d. The average per capita flow was 496 L/cap·d, which is higher than a typical range of 225-450 L/cap·d for domestic sewage. This is attributed to the historical I/I issues in the collection system.

Table 20 Historic Flow to the St Jacobs WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	1,450	-
Rated Peak Flow Rate (m ³ /d)	5,180	-
ADF (m ³ /d)	920 (65%)	-
PDF (m ³ /d)	2,600	2.8 ⁽¹⁾
PHF (m ³ /d)	3,100	3.3 ⁽²⁾
PIF (m ³ /d)	3,300	3.6 ⁽³⁾
Average Per Capita Flow (L/cap·d)	500 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Estimated based on on-site pumping station rated capacity and plant rated capacity.
4. Based on ADF of 920 m³/d and a 2014 population of 1,858 provided in the Region's 2015 WWMR.

4.6.2 Effluent Limits

The St Jacobs WWTP historically has produced good quality effluent that has met the MOECC ECA effluent limits for the historic review period (2012-2014), with the exception of one elevated value in January 2014 for TAN due to extreme cold temperature affecting the nitrification performance of the oxidation ditch. A process adjustment was made to improve treatment by maintaining a higher concentration of solids to promote biomass activity, enabling the facility to meet compliance.

The Conestogo River is a MOECC Policy 2 receiver for TP as the background TP concentrations consistently exceed the PWQO of 0.03 mg/L (GRCA, 2011). Per Policy 2 requirements, the TP loading of the plant effluent cannot be increased beyond the current ECA approved loading. Accordingly, the St Jacobs WWTP may have changes to current effluent quality limits with any plant expansion. Suggested future effluent objectives for an expanded St Jacobs WWTP are provided in Section 3.3.5 of this report. Overall, the proposed effluent objectives are consistent with the performance of an optimized single stage tertiary treatment facility. Effluent objectives will need to be confirmed during a Schedule C Class EA for the St Jacobs WWTP expansion.

4.6.3 Process Capacity Summary

A capacity review for the major liquid and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Figure 9 summarizes the unit process capacities at the St Jacobs WWTP.

There is sufficient capacity at the plant to treat the design flow, with the exception of the tertiary filters and the UV disinfection system due to the elevated I/I flows in the collection system. A joint I/I reduction program was undertaken by the Township and the Region from 1997 to 2007 to target reductions in extraneous flows (St Jacobs I/I Reduction Program). Although some upgrades were completed in the collection system, I/I contributions are still elevated and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, per capita flows would be reduced and capacity may be gained at the plant. Overall, the plant capacity is currently limited to approximately 1,080 m³/d by the tertiary filters and UV disinfection system.

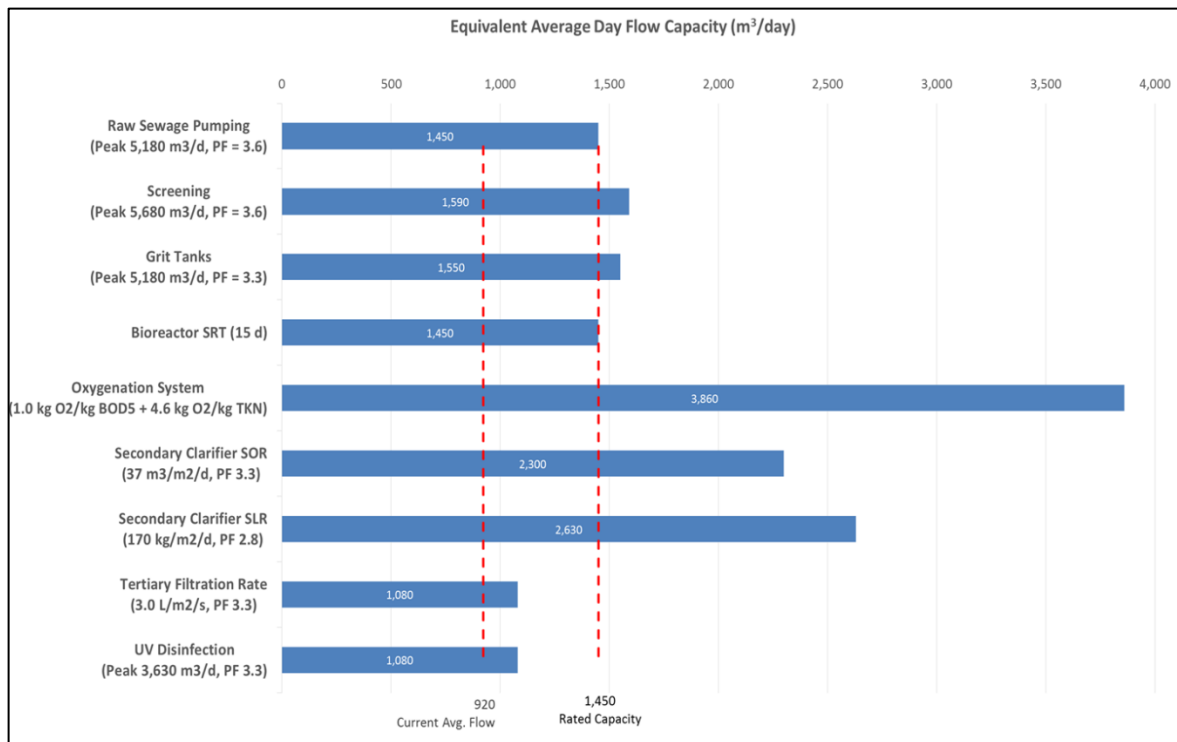


Figure 9 St Jacobs WWTP Unit Process Capacity Summary

It is important to note that the ADF capacity of the bioreactor at the St Jacobs WWTP may actually be lower than identified above, as very low temperatures (<3°C) experienced in the oxidation ditch in the winter have had a negative impact on nitrification performance (XCG, 2013).

4.6.4 Status of 2007 WWTMP Projects

The Region has recently initiated a project to optimize the St Jacobs WWTP and address unit process deficiencies as recommended in the 2007 WWTMP. The long-term expansion to 2,500 m³/d (as identified in the 2007 WWTMP) is being re-evaluated as part of this Master Plan update.

The Region completed the St Jacobs – Elmira Wastewater Treatment Master Plan (WWTMP) in 2013. The WWTMP recommended conversion of St Jacobs WWTP into a pumping station and conveying flows to Waterloo WWTP when additional capacity is necessary (XCG, 2013). Upgrades for conversion to a pumping station have not been completed because additional capacity was not needed. This recommendation is being re-evaluated as part of this master plan update.

4.6.5 Future Opportunities/Constraints

The St Jacobs WWTP will require a minor expansion within the planning period. There is sufficient capacity on-site for conventional expansion. However, with the planned short-term upgrades (aerator replacement, insulated aeration covers) coupled with I/I reduction, there may be opportunity to increase capacity with minimal additional tankage construction.

4.7 Elmira WWTP

The Elmira WWTP is a BNR plant that provides treatment for wastewater generated in the Town of Elmira located in the Township of Woolwich. The plant is operated under MOECC ECA No. 6698-8QGJ8E issued on January 27, 2012. The Elmira WWTP has a rated ADF capacity of 7,800 m³/d and a peak flow capacity of 19,500 m³/d.

The existing unit treatment processes include flow equalization, screening, vortex grit removal, primary clarification, BNR bioreactors (i.e. a combined anaerobic-anoxic-aeration process), secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Canagagigue Creek. The addition of ferric chloride upstream of the secondary clarifiers for phosphorus removal is provided to improve the performance of the BNR system. Primary sludge is transferred to a fermenter tank for volatile fatty acid (VFA) production. The supernatant from the fermenter tank can be returned to the anaerobic zone of the bioreactors to facilitate biological phosphorus removal. WAS is transferred to a sludge blend tank for blending with fermented sludge and storage. The fermented sludge and WAS are dewatered in a centrifuge, with haulage off-site for disposal in a landfill.

4.7.1 Flow

Table 21 summarizes the historic flow to the Elmira WWTP over the period from 2012 to 2014. The average raw wastewater flow during the review period was 4,400 m³/d, or approximately 55% of the rated capacity of 7,800 m³/d. The average per capita flow was 450 L/cap·d, which is in the higher end of a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The high average per capita flow may be attributed to additional contribution from industrial areas and historical I/I issues experienced in the collection system. The peak raw wastewater flow was 13,890 m³/d, or approximately 70% of the peak flow capacity of 19,500 m³/d.

Table 21 Historic Flow to the Elmira WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	7,800	-
Rated Peak Flow Rate (m ³ /d)	19,500	-
ADF (m ³ /d)	4,400 (55%)	-
PDF (m ³ /d)	13,890	3.2 ⁽¹⁾
Average Per Capita Flow (L/cap·d)	450 ⁽²⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Based on ADF of 4,400 m³/d and a 2014 population of 9,896 provided in the Region's 2015 WWWMR.

4.7.2 Effluent Limits

The Elmira WWTP has historically produced good quality effluent during the review period (2012-2014) that has met the ECA compliance limit, with the exception of the TAN monthly average concentration in February to April 2012. This was due to increased hydraulic loading and/or inhibitory influent loading. Process adjustments were made to ensure a more consistent hydraulic and organic loading to the secondary treatment system by improved utilization of the equalization tanks.

The Canagagigue Creek is a MOECC Policy 2 receiver for TP as the background TP concentrations consistently exceed the PWQO of 0.03 mg/L (GRCA 2011). Per Policy 2 requirements, the TP loading of the plant effluent cannot be increased beyond the current ECA approved loading. Accordingly, the Elmira WWTP is expected to have changes to current effluent quality limits for any future plant expansion. Suggested effluent objectives for an expanded Elmira WWTP are provided in Section 3.3.6 of this report. Overall, the proposed effluent objectives are consistent with the performance of an optimized single stage tertiary treatment facility. Effluent objectives will need to be confirmed during a Schedule C Class EA for the Elmira WWTP expansion.

4.7.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved

ECA capacities, and typical design guidelines. Figure 10 summarizes the unit process capacities at the Elmira WWTP.

Several treatment processes at the Elmira WWTP do not have sufficient capacity for the current plant design flow, including the primary clarifiers, bioreactors, oxygenation system, UV disinfection system and sludge blending tank.

The aerobic zone SRT and oxygen availability are the most limiting factors of the plant. This is due to the historic elevated influent BOD₅ concentrations (i.e. average 260 mg/L) from industrial sources compared to the original plant design concentration of 190 mg/L (Stanley, 1998). If the influent BOD₅ loadings were similar to the original design basis, additional capacity of the bioreactors and oxygenation system would be available.

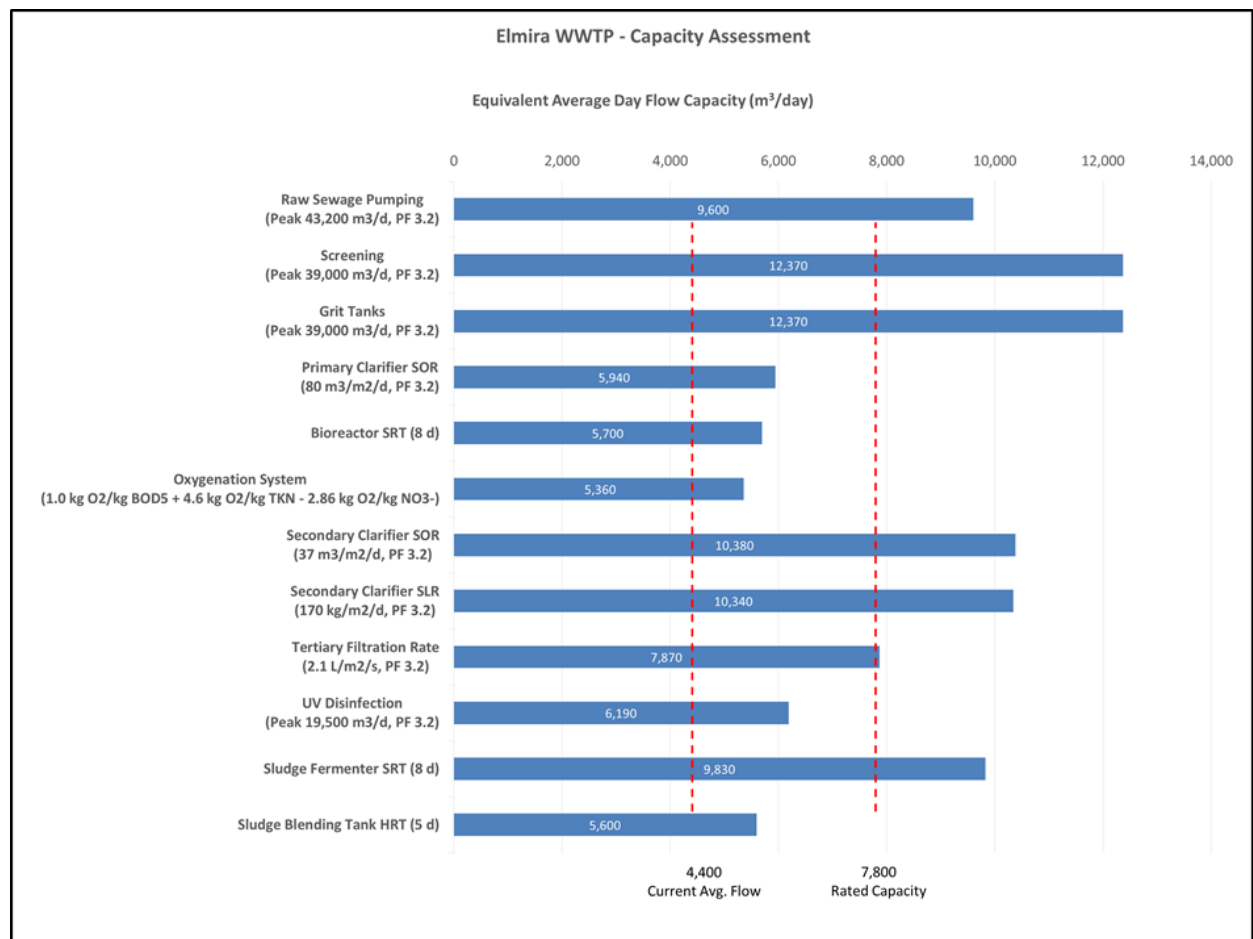


Figure 10 Elmira WWTP Unit Process Capacity Summary

The high influent concentrations are currently being addressed by the Region through enforcement of the Sewer Use By-Law, and changes are being made by some of the major industrial contributors in an effort to reduce raw influent loadings and increase plant capacity. Recent data has shown significant reductions in loadings from major industrial contributors beginning in early 2018. Continued monitoring and enforcement of the bylaw may further reduce influent loading at the plant, however, the timing and extent of reductions are not definitively known.

The primary clarifiers and UV disinfection system have sufficient capacity for the current flow but not for the plant design flow. This is due to the significant I/I issue experienced at the plant, which results in higher sustained wet weather flows and higher peak flows (i.e. a historic peak day factor of 3.2 based on the plant data) than original design values (i.e. a peak day factor of 2.5).

A joint program was undertaken by the Township and the Region from 1997 to 2007 to target reductions in extraneous flows. Although some upgrades were completed in the collection system, I/I contributions are still elevated and likely related to extraneous flows from private services. If the I/I issues are addressed in the future and extraneous flows are reduced, the capacity of the primary clarifiers and UV disinfection system may be gained at the plant.

The sludge blending tank has an equivalent average day capacity of 5,600 m³/d, compared to the rated capacity of 7,800 m³/d. The blending tank is too small for the current operation; therefore, additional storage volume is required.

Overall, the Elmira WWTP has an available equivalent ADF capacity of approximately 5,360 m³/d, specifically limited by the oxygenation system as identified above.

4.7.4 Status of 2007 WWTMP Projects

The Phase 1 recommendations have been completed, including two new equalization tanks, replacement of the filter press with a centrifuge for dewatering, upgrades to RAS/WAS flow split chamber at the head of the aeration tanks, and installation of channel aeration. The Phase 2 expansion to 10,000 m³/d (as identified in the 2007 WWTMP) is being re-evaluated based on this Master Plan update.

4.7.5 Future Opportunities/Constraints

Expansion of the Elmira WWTP will likely be required within the planning period. Key opportunities and constraints for the Elmira WWTP include:

- + High extraneous flows limit the capacity of some unit processes. A reduction in I/I can reduce future tankage requirements and preserve site capacity.
- + High industrial loading contributions limit aeration capacity. Working with local industries could potentially reduce future tankage and aeration requirements and preserve site capacity.

4.8 Ayr WWTP

The Ayr WWTP is an extended aeration package plant that provides treatment for wastewater generated in the Village of Ayr in the Township of North Dumfries. The plant is currently operated under MOECC ECA No. 4800-6GMFXG issued on October 20, 2005, with a rated ADF capacity of 3,000 m³/d and a peak flow capacity of 8,100 m³/d.

The existing unit treatment processes include screening, aerated grit removal, aeration, secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Nith River. Ferric chloride is added to the mixed liquor prior to the secondary clarifiers for phosphorus removal. Waste activated sludge is aerobically digested, with liquid digested sludge stored on-site in the biosolids lagoons prior to land application.

4.8.1 Flow

Raw wastewater is conveyed to the Ayr WWTP via the Rose Street SPS. A summary of the historical flow data for the Ayr WWTP over the period from 2012 to 2014 is presented in Table 22. The average raw wastewater flow during the review period was 1,298 m³/d, or approximately 45% of the rated capacity of 3,000 m³/d. The average per capita flow was 270 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The peak raw wastewater flow was 1,750 m³/d, or approximately 22% of the peak flow capacity of 8,100 m³/d.

Table 22 Historic Flow to the Ayr WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	3,000	-
Rated Peak Flow Rate (m ³ /d)	8,100	-
ADF (m ³ /d)	1,300 (45%)	-
PDF (m ³ /d)	1,750	1.4 ⁽¹⁾
PHF (m ³ /d)	2,400	1.9 ⁽²⁾
PIF (m ³ /d)	3,500	2.7 ⁽³⁾
Average Per Capita Flow (L/cap·d)	270 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal fluctuation.
3. Assumed based on ECA peaking factor.
4. Based on ADF of 1,300 m³/d and a 2014 population of 4,879 provided in the Region's WWWMR.

4.8.2 Effluent Limits

The Ayr WWTP historically has produced good quality effluent that has met the MOECC effluent limits for the historic review period (2012 – 2014). All annual average loadings are within the ECA effluent objectives and non-compliance limits. The plant achieves a high level of year-round nitrification and tertiary phosphorus removal. With no expansion of the Ayr WWTP in the planning period, the existing effluent limits are expected to remain unchanged.

4.8.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Figure 11 summarizes the unit process capacities at the Ayr WWTP.

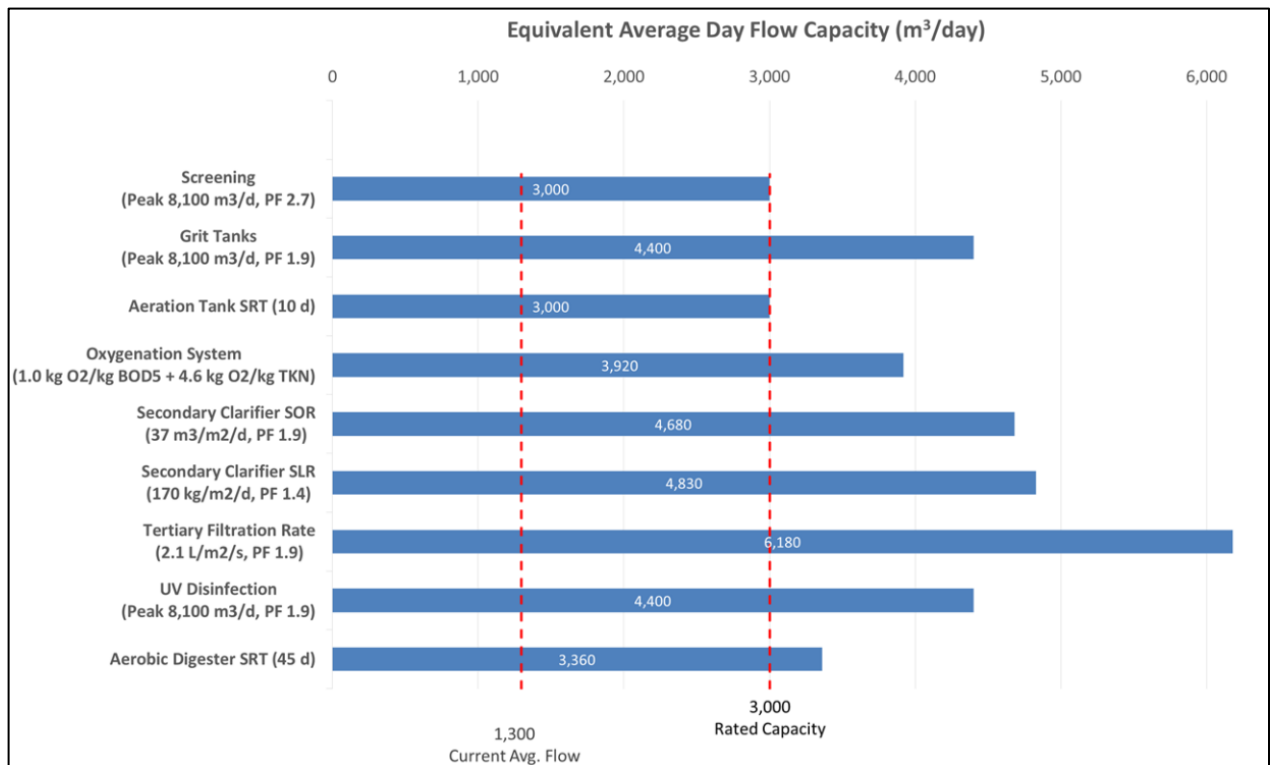


Figure 11 Ayr WWTP Unit Process Capacity Summary

All unit treatment processes have sufficient capacity for the plant design flow of 3,000 m³/d.

4.8.4 Status of 2007 WWTMP Projects

The Ayr WWTP was expanded to 3,000 m³/d just prior to completion of the 2007 WWTMP. The long-term recommendations for expansion to 4,500 m³/d (as identified in the 2007 WWTMP) are being re-evaluated as part of this Master Plan update.

4.8.5 Future Opportunities/Constraints

A new raw wastewater pumping station (Ayr SPS) is close to completion and will convey wastewater from a new development in the Village of Ayr to the Ayr WWTP. As such, the Ayr WWTP will have two SPSs that convey all flows from the community to the plant. While the average day capacity will remain below the rated capacity, the peak hydraulic capacity of the plant should be reviewed relative to the capacity and proposed operation of the existing and new pumping stations.

4.9 New Hamburg WWTP

The New Hamburg WWTP is a sequencing batch reactor (SBR) activated sludge facility that provides treatment for wastewater generated in the communities of Baden and New Hamburg in the Township of Wilmot. The plant is operated under MOECC ECA No. 9330-6G9K5B issued on November 22, 2005, and has a rated ADF capacity of 5,200 m³/d.

The existing unit treatment processes consist of screening, vortex grit removal, SBR secondary treatment, flow equalization, tertiary sand filtration and UV disinfection prior to discharge to the Nith River. Alum is added to the SBR feed channel and/or upstream of the sand filters for phosphorus removal. Waste activated sludge from the SBRs is pumped to the aerobic digesters for stabilization. In the original design, biosolids were transferred to a stabilized biosolids storage lagoon for long term storage and subsequently beneficially used in agriculture. The stabilized biosolids storage lagoon has since been converted to a hauled waste receiving station. As a result, the aerobic digesters are now used for both digestion and biosolids storage. An on-site emergency storage lagoon is used for temporary storage of plant overflows during wet weather conditions.

Currently, the Region is completing detailed design for the plant expansion, which will increase the rated ADF capacity to 6,900 m³/d and increase the peak flow capacity to 30,360 m³/d. For the purpose of this Master Plan Update, plant capacity is based on the expanded plant, as the expansion is expected to be completed within the next three (3) years.

4.9.1 Flow

Table 23 summarizes the historic flow to the New Hamburg WWTP over the period from 2012 to 2014. The average raw wastewater flow during this review period was 3,700 m³/d, or approximately 70% of the existing rated capacity of 5,200 m³/d. The average per capita flow was 290 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

Table 23 Historic Flow to the New Hamburg WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor ⁽¹⁾
Rated ADF Capacity (m ³ /d)	6,900 ⁽¹⁾	-
Rated Peak Flow Rate (m ³ /d)	30,360	-
ADF (m ³ /d)	3,700 (55%)	-
PDF (m ³ /d)	8,000	2.15 ⁽²⁾
PHF (m ³ /d)	10,300	2.78 ⁽²⁾
PIF (m ³ /d) to Raw Sewage Pumping Station	16,330	4.40 ⁽³⁾
PIF (m ³ /d) to Screening	15,470	4.17 ⁽⁴⁾
Average Per Capita Flow (L/cap·d)	290 ⁽⁵⁾	-

Notes:

1. Rated capacity of the Phase 2 expanded New Hamburg WWTP (HMM, 2015).
2. Based on the peaking factors in the New Hamburg WWTP Preliminary Design Report (HMM, 2015).
3. The PIFs are based on the Morningside SPS operation/capacity, as all flows are conveyed to the plant via the Morningside SPS.
4. Based on the peaking factor in the New Hamburg WWTP Preliminary Design Report. Peak flows in excess of screening capacity will be diverted to the Emergency Storage Basin (HMM, 2015).
5. Based on a historic ADF of 3,700 m³/d and a 2014 population of 12,787 provided in the Region's 2015 WWWWMR.

4.9.2 Effluent Limits

The New Hamburg WWTP has been able to achieve its effluent compliance limits for the historic review period (2012 – 2014), with the exception of the TAN monthly average concentration in August 2014 due to an equipment failure and a TSS monthly average concentration in February 2014 due to an upset condition experienced at the plant.

The New Hamburg WWTP expansion will be based on new effluent limits consistent with the recommendations of the ACS. Further expansion of the facility is not required in the planning period. As a result, effluent limits associated with the most recent expansion are expected to remain unchanged over the planning period.

4.9.3 Process Capacity Summary

A capacity review for the major liquid and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The

review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. In addition, the expanded plant was used for the capacity review, as the expansion is expected to be completed within the next three (3) years. Figure 12 summarizes the unit process capacities at the New Hamburg WWTP.

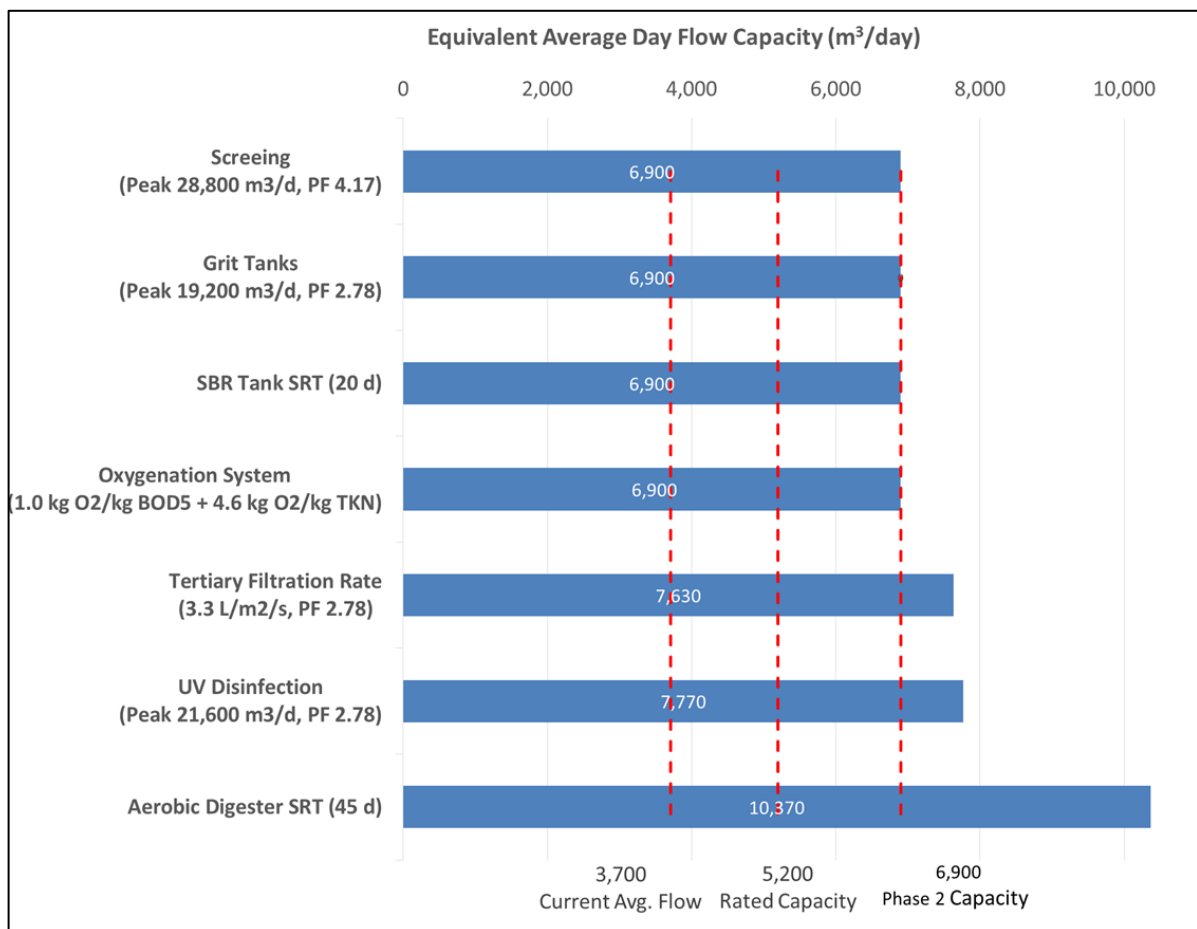


Figure 12 New Hamburg WWTP Unit Process Capacity Summary

All unit treatment processes provide sufficient capacity for the design flow of 6,900 m³/d, upon the completion of the plant expansion.

The dual use of the aerobic digesters for digestion and storage has resulted in a bottleneck at the plant when considering future loads, even with no outside biosolids (AECOM, June 2011). With the construction of the hauled waste receiving station at the Manitou Drive Biosolids Dewatering Facility to divert hauled waste from the New Hamburg WWTP, this bottleneck will be alleviated. The aerobic digesters will then have sufficient capacity for the projected 2051 flows.

4.9.4 Status of 2007 WWTMP Projects

The Region is in the process of completing the initial expansion of the New Hamburg WWTP as recommended in the 2007 WWTMP. A second longer term expansion to 10,500 m³/d (as identified in the 2007 WWTMP) is being re-evaluated as part of this Master Plan update.

4.9.5 Future Opportunities/Constraints

The New Hamburg WWTP has sufficient capacity to handle 2051 flows.

4.10 Wellesley WWTP

The Wellesley WWTP is an extended aeration package plant that provides treatment for wastewater generated in the Township of Wellesley. The treatment plant is currently operated under MOECC Certificate of Approval (CofA) No. 3-0048-91-006 issued on May 15, 1991, with a rated ADF capacity of 1,100 m³/d and a peak flow capacity of 4,400 m³/d.

The existing unit treatment processes include manually cleaned screens, aeration, secondary clarification, tertiary filtration and ozone disinfection prior to discharge to the Nith River. Alum is added to aeration tank effluent for phosphorus removal. Waste activated sludge is stored in an aerated sludge holding tank prior to being hauled to the Waterloo WWTP for further processing.

4.10.1 Flow

A summary of the historical flow data for the Wellesley WWTP is presented in Table 24 over the period from 2012 to 2014. The average raw wastewater flow during the review period was 870 m³/d, or approximately 80% of the rated capacity of 1,100 m³/d. The average per capita flow was 266 L/cap·d, which is within the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

Table 24 Historic Flow to the Wellesley WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	1,100	-
Rated Peak Flow Rate (m ³ /d)	4,400	-
ADF (m ³ /d)	870 (80%)	1.0
PDF (m ³ /d)	3,100	3.5 ⁽¹⁾
PHF (m ³ /d)	3,500	4.0 ⁽²⁾
PIF (m ³ /d)	3,500	4.0 ⁽²⁾
Average Per Capita Flow (L/cap·d)	270 ⁽³⁾	-

Notes:

1. Based on historic data (January 2012 – December 2014).
2. Assumed based on ECA peaking factor and Operation and Maintenance Manual of the Wellesley WWTP (1992).
3. Based on ADF of 870 m³/d and a 2014 population of 3,270 provided in the Region's 2015 WWMR.

4.10.2 Effluent Limits

Based on the plant effluent quality for the historic review period (2012 – 2014), the Wellesley WWTP has produced good quality effluent that has met the compliance limits, except one elevated value for TAN in March 2012 due to an air supply line failure at the plant. Repair was made to the air supply line and compliance was restored in April 2012. Overall, the plant is required to meet stringent effluent ammonia nitrogen (TAN of 0.75 mg/L) and phosphorus (TP of 0.5 mg/L) limits.

The Nith River is a MOECC Policy 2 receiver for TP as the background TP concentrations consistently exceed the PWQO of 0.03 mg/L (GRCA 2011). Per Policy 2 requirements, the TP loading of the plant effluent cannot be increased beyond the current ECA approved loading. Accordingly, the Wellesley WWTP may have changes to current effluent quality limits with any plant expansion. Suggested future effluent objectives for the Wellesley WWTP are provided in Section 3.3.4 of this report. Overall, effluent objectives are consistent with the performance achievable from a conventional single stage tertiary filtration facility with optimized chemical dosing. Effluent objectives will need to be confirmed during a Schedule C Class EA for the Wellesley WWTP expansion.

4.10.3 Process Capacity Summary

A capacity review for the major liquids and solids unit processes was performed to evaluate the capabilities of the existing facility to meet effluent requirements. The review was based on historical plant operational data, plant design criteria, approved ECA capacities, and typical design guidelines. Figure 13 summarizes the unit process capacities at the Wellesley WWTP.

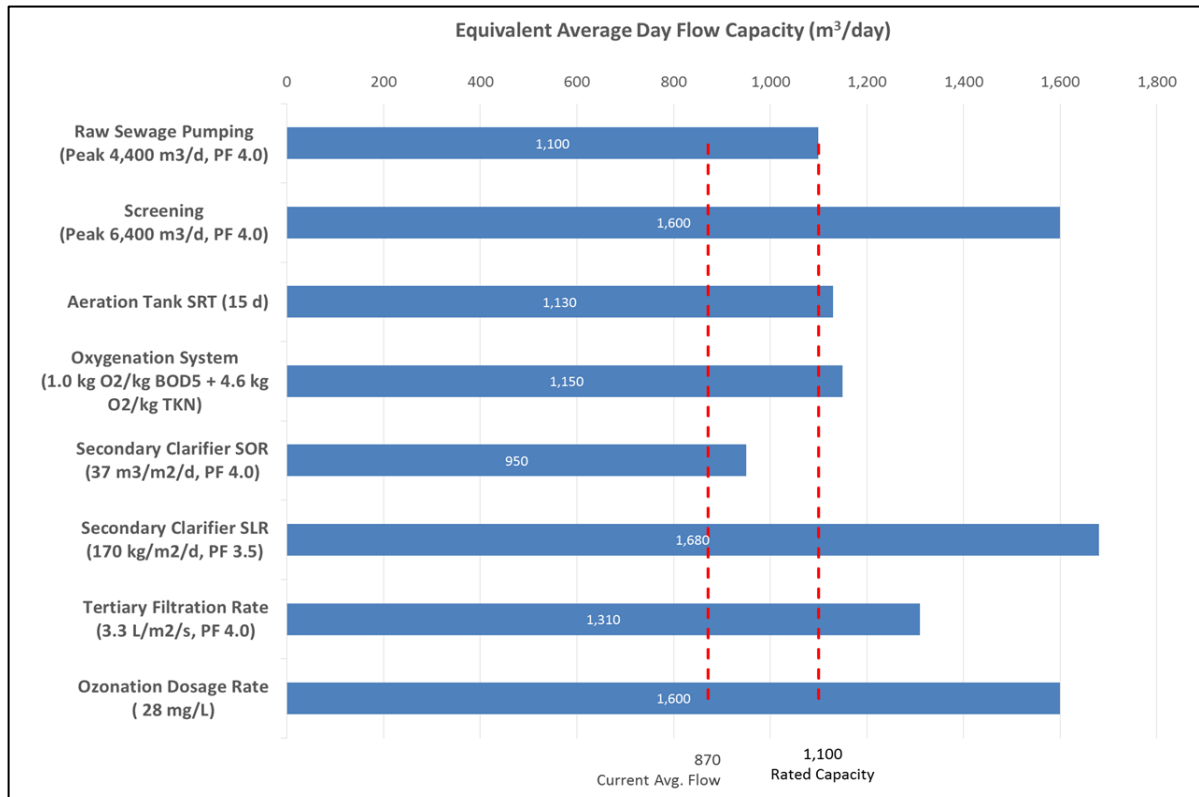


Figure 13 Wellesley WWTP Unit Process Capacity Summary

The capacity of the Wellesley WWTP is slightly less than the design flow of 1,100 m³/d, due to limited secondary clarification capacity. The reduced secondary clarifier capacity is a result of high I/I experienced in the collection system, which results in high wet weather flows and high peak factors (i.e. a PHF of 4.0). It can be noted that even though high I/I is experienced in the collection system, due to the nature of the I/I, it results primarily in increased peak flows at the plant and not in higher per capita averages for the catchment. If I/I is reduced, the secondary clarification capacity may be gained. However, I/I reductions can be difficult to achieve and challenging to quantify the impacts on treatment capacity improvements in advance.

4.10.4 Status of 2007 WWTMP Projects

The Region is currently reviewing opportunities to reduce I/I in the Wellesley WWTP collection system as recommended in the 2007 WWTMP. The decision to implement equalization and/or alternative technologies for expansion are being re-evaluated based on the findings of the on-going I/I improvements and recommendations from this WWTMP update.

4.10.5 Future Opportunities/Constraints

Filters at the Wellesley WWTP have recently been replaced with disk cloth filters. Other overall plant upgrades will be initiated by mid-2018 to improve operability and maintain the WWTP effluent quality in accordance with the ECA. There is space available for construction of a new parallel extended aeration plant, if required.

4.11 Conestogo WWTP

The Conestogo WWTP, a sequencing batch reactor plant, was constructed to service the residential subdivision of a private development in the Town of Conestogo. The plant is currently operated under MOECC ECA No. 8637-5L7MVC issued on April 10, 2003. The plant has a rated ADF capacity of 148 m³/d and a peak flow capacity of 660 m³/d.

The existing unit treatment processes include sequencing batch reactor secondary treatment, tertiary filtration and UV disinfection prior to discharge to the Grand River. Alum is added to the SBR tanks for phosphorus removal. Sludge generated is hauled to the Waterloo WWTP for further treatment.

Table 25 summarizes historic flows to the Conestogo WWTP for the review period from 2012 to 2014. The average raw wastewater flow during the review period was 40 m³/d, or approximately 30% of the rated capacity of 148 m³/d. The average per capita flow was 169 L/cap·d, which is below a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

The Conestogo WWTP tertiary filter upgrades have recently been completed and will improve operability and maintain the WWTP effluent quality in accordance with the ECA.

No changes are expected in the rated capacity or effluent quality requirements for the Conestogo WWTP within the planning period, as it is a communal treatment plant servicing a single community.

Table 25 Historic Flow to the Conestogo WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	148	-
Rated Peak Flow Rate (m ³ /d)	660	-
ADF (m ³ /d)	40 (30%)	-
PDF (m ³ /d)	150	3.5 ⁽¹⁾
PHF (m ³ /d)	170	4.0 ⁽²⁾
PIF (m ³ /d)	190	4.4 ⁽³⁾
Average Per Capita Flow (L/cap·d)	169 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Estimated based on on-site pumping station rated capacity and plant rated capacity.
4. Based on an ADF of 43 m³/d and a 2014 population of 252 provided by the Region's 2015 WWWWMR.

4.12 Foxboro Green WWTP

The Foxboro Green WWTP, originally constructed in 1999, is a rotating biological contactor (RBC) plant that provides BOD removal and nitrogen removal (nitrification and denitrification) for wastewater generated in the Foxboro Green Retirement Community in the Township of Wilmot. The Foxboro Green WWTP is operated under MOECC ECA No. 7201-8ZMQGA issued on March 20, 2013. The treatment facility consists of three packaged RBC plants (Plants No. 1, 2 and 3). Each plant has a rated ADF capacity of 50 m³/d, with a total rated ADF capacity of 150 m³/d and a peak flow capacity of 680 m³/d.

The existing unit treatment processes include primary clarification, rotating contactors, intermediate clarification, denitrification, and final clarification prior to discharge to seven subsurface disposal leaching beds (Leaching Beds A, B, C, D, E, F and G). There is no chemical used in the RBC process and disinfection is not required for the leaching bed system. WAS is returned to the primary settling tanks for co-thickening. Co-thickened primary sludge and WAS are hauled to the Waterloo WWTP for further treatment.

A summary of the historical flow data for the Foxboro Green WWTP over the period of 2012 to 2014 is presented in Table 26. The average raw wastewater flow during the review period was 110 m³/d, or approximately 75% of the rated capacity of 150 m³/d. The average per capita flow was 273 L/cap·d, which is within a typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008).

Table 26 Historic Flow to the Foxboro Green WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	150	-
Rated Peak Flow Rate (m ³ /d)	680	-
ADF (m ³ /d)	110 (75%)	-
PDF (m ³ /d)	240	2.1 ⁽¹⁾
PIF (m ³ /d)	290	2.6 ⁽²⁾
PHF (m ³ /d)	440	4.0 ⁽³⁾
Average Per Capita Flow (L/cap·d)	270 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations.
3. Based on Harmon formula.
4. Based on ADF of 110 m³/d and a 2014 population of 417 provided in the Region's 2015 WWMR.

The Foxboro Green WWTP is a communal treatment plant servicing a single community. No changes are expected in the rated capacity or effluent quality requirements in the planning period.

4.13 Alt-Heidelberg WWTP

The Alt-Heidelberg WWTP is a BNR plant that provides treatment for wastewater from approximately 90 homes within the Community of Heidelberg in the Township of Woolwich. The Alt-Heidelberg WWTP is operated under MOECC ECA No. 9893-97RR3P issued on June 19, 2013. The plant has a rated ADF capacity of 130 m³/d and a peak flow capacity of 276 m³/d.

The existing unit treatment processes include equalization, BNR bioreactors (consisting of anaerobic, anoxic and aerobic cells), secondary clarification, tertiary filtration and UV disinfection prior to discharge to the Heidelberg Creek. Ferric chloride is added to the aeration tanks for phosphorus removal. Sludge generated

from the BNR process is aerated and hauled to the Waterloo WWTP for further processing.

A summary of the historical flow data of the Alt-Heidelberg WWTP over the period from 2012 to 2014 is presented in Table 27. The Alt-Heidelberg WWTP average raw wastewater flow during the review period was 60 m³/d, or approximately 50% of the rated capacity of 130 m³/d. The average per capita flow was 240 L/cap·d, which is within the typical range of 225-450 L/cap·d for domestic sewage (MOECC, 2008). The peak raw wastewater flow was 170 m³/d, or approximately 62% of the peak flow capacity of 276 m³/d.

Table 27 Historic Flow to the Alt-Heidelberg WWTP (2012-2014)

Parameters	Influent Flow (% of Rated Capacity)	Peak Factor
Rated ADF Capacity (m ³ /d)	130	-
Rated Peak Flow Rate (m ³ /d)	276	-
ADF (m ³ /d)	60 (50%)	-
PDF (m ³ /d)	170	2.7 ⁽¹⁾
PHF (m ³ /d)	200	3.2 ⁽²⁾
PIF (m ³ /d)	250	4.1 ⁽³⁾
Average Per Capita Flow (L/cap·d)	240 ⁽⁴⁾	-

Notes:

1. Based on historic data (January 2012 to December 2014).
2. Assumed based on PDF plus 50% of ADF to allow for diurnal variations
3. Estimated based on on-site raw sewage pumping station rated capacity and plant ECA rated capacity.
4. Based on an ADF of 60 m³/d and a 2014 population of 263 provided in the WWWMR.

The Alt-Heidelberg WWTP is a communal treatment plant servicing a single community. No changes are expected in the rated capacity or effluent quality requirements in the planning period.

4.14 Sewage Pumping Stations

As part of this Master Plan update, the Region-owned SPSs were also evaluated to identify if the existing SPSs have sufficient capacity to handle the current and projected flow. The capacity assessment of the pumping stations was based on reviewing the current peak wet weather flows (PWWFs) to the station, the existing

station firm capacity (i.e., capacity with the largest pump out of service), and forecasted future flows for the planning horizon up to 2051.

4.14.1 Spring Valley SPS

The Spring Valley SPS is situated within the City of Kitchener and pumps wastewater from a portion of the City of Kitchener collection system to a trunk sewer system that ultimately goes to the Kitchener WWTP. The pumping station is operated under MOECC CofA No. 3-0871-92-006, issued on August 4, 1992.

The Spring Valley SPS is equipped with three 195 L/s pumps (two duty, one standby) at a total dynamic head (TDH) of 34.8 m. The Spring Valley SPS Upgrade Preliminary Design Report (R.V. Anderson, 2015) estimated the firm capacity of the station to be 245 L/s based on two pumps operating in parallel and a forcemain C-factor of 120.

As part of a study of the Spring Valley SPS, a hydraulic assessment was completed for the existing system. Field testing suggested a very low C-Factor of 73 for the existing forcemain. It was recommended that the existing pumps be replaced with new pumps of suitable head, in order to maintain the firm station capacity of 245 L/s, while allowing for the decreased C-factor (R.V. Anderson, 2015).

The current PWWF into the station is 207 L/s observed on July 14, 2015, which is approximately 85% of the station's firm capacity. The 2051 projected PWWF of 252 L/s will slightly exceed the existing firm capacity.

The Spring Valley SPS is in the process of upgrades to replace the existing raw sewage pumps with new units sized to meet the current station capacity of 245 L/s (R.V.A., July 2015). Construction is anticipated to take place by late 2018. Additional work for the station will also be necessary within the next 10 years based on the age of the assets. A Class EA study is to be completed to look at the preferred approach for asset renewal, whether it be upgrades to the existing station or constructing a new pumping station. Potential changes to the forcemain alignment as related to the upcoming Ministry of Transportation of Ontario work should also be considered during the Class EA.

A Feasibility Study was recently completed by the Region to investigate the potential diversion of the Bridgeport SPS flows from the Waterloo WWTP to the Kitchener WWTP by utilizing the Spring Valley SPS. The diversion of these flows is intended to make capacity available at the Waterloo WWTP. In order for this diversion to be

possible, the Feasibility Study estimated that the capacity of the Spring Valley SPS and downstream conveyance infrastructure be increased from 245 L/s to 381 L/s (R.V. Anderson, July 2016). As part of this Master Plan update, the feasibility of this option was to be re-evaluated. Flow projections from the Master Plan were also to be used to confirm what capacity would be required for the Spring Valley SPS should Bridgeport SPS be diverted.

4.14.2 Bridgeport SPS

The Bridgeport SPS is situated within the City of Kitchener. The station receives wastewater from the City of Kitchener and the City of Waterloo, discharging to a trunk sewer that ultimately conveys flows to the Waterloo WWTP. The pumping station is operated under the MOECC ECA No. 7007-8CUJZV, issued on January 24, 2011.

The Bridgeport SPS is equipped with two 136 L/s variable speed pumps (one duty, one standby) and one 68 L/s fixed speed jockey pump. The firm capacity of the station is 136 L/s with one variable speed pump operating. The firm capacity does not include the capacity of the jockey pump, as this pump cannot operate at the same time as the larger variable speed pumps due to the lower design operating head.

The current PWWF into the station is 85 L/s, observed on March 31, 2015, which is approximately 60% of the station's firm capacity. The projected 2051 PWWF for the station is 114 L/s; therefore, the existing station has sufficient capacity for projected flows within the planning period. As mentioned in Section 4.14.1, the option for diverting flows from the Bridgeport SPS to the Spring Valley SPS is being re-evaluated as part of the 2018 WWTMP Update.

4.14.3 Baden SPS

The Baden SPS is located on Foundry Street in Baden, between Gingerich Rd and Highway 8. The Baden SPS collects wastewater from the community of Baden and conveys it to the Morningside SPS via a 200 mm forcemain, where it is then pumped to the New Hamburg WWTP for treatment. The pumping station is operated under MOECC ECA No. 4162-4LKPG5, issued on June 28, 2000.

The Baden SPS is a dry/wet well configuration. The dry well is equipped with two non-clog dry pit pumps each rated at 49 L/s and one jockey pump rated at 25 L/s which pump wastewater into the 200 mm forcemain. The wet well is equipped with three submersible pumps each rated at 46.7 L/s (total flow of 140 L/s with all three

pumps operating), which divert flow to an equalization tank (1,400 m³) during high peak flow events.

The peak wet weather discharge flow measured for the station during the historic review period is 185 L/s, observed on September 10, 2014, which is approximately 98% of the existing station's wet weather capacity. Based on previous investigations for the station, it is noted that the capacity of the station is sufficient under dry and most wet weather flow conditions; however, during very high wet weather flows, the station capacity is exceeded. Presently, these high flow events are resolved by contracting vacuum trucks and tankers to haul the excess wastewater directly to the New Hamburg WWTP. The 2011 Baden-New Hamburg Wastewater Master Plan Update recommended that I/I flows be reduced or additional equalization storage capacity be provided at the Baden SPS to accommodate the very high flow events (AECOM, 2011).

In 2012, an Investigation Study was completed for the Baden SPS to provide recommendations for upgrading the pumping station (HMM, 2012). The Investigation Study identified the firm capacity of the dry well pit pumps as 47 L/s based on the pump and system curves with one existing dry pit pump operating and a forcemain C-factor of 120. The firm capacity does not include the jockey pump, as the jockey pump cannot operate at the same time as the larger dry pit pumps due to the lower operating head. The 2012 Investigation Study also identified the firm capacity of the wet well pumps at 140 L/s based on all three submersible pumps operating. Therefore, the total firm capacity of the Baden SPS can handle a peak wet weather flow of is 187 L/s (i.e., 47 L/s + 140 L/s).

The original preliminary design completed for the Baden station estimated that the wet weather flow capacity could be increased to 200 L/s with replacement of the existing two 49 L/s dry pit pumps with two new 60 L/s pumps (Stanley, 1998). With the increased pump capacity, the flow velocity of the existing 200 mm forcemain would be 1.9 m/s, which would still be below the maximum velocity of 3.0 m/s recommended by MOECC Design Guidelines (2008). However, according to the 2012 Baden SPS Investigation Study, replacing the pumps would require extensive electrical upgrades due to the increase in pump horsepower. It was recommended that the preferred option be to continue hauling of excess flow during the very high flow events up to 2041 (HMM, 2012).

Projected 2051 PWWF for the station is 226 L/s, which exceeds the existing station's wet weather capacity. To handle the 2051 peak wet weather flows, it is recommended that options to increase the capacity of the Baden SPS be reviewed, which may include continuing hauling of excess flows, and/or installation of an additional pump or equalization storage tank. It is important to note that any changes to the pumping capacity at the Baden SPS would need to consider impacts to downstream facilities. The Baden SPS discharges to the collection system in New Hamburg to convey flows to the Morningside SPS, which then pumps flows to the New Hamburg WWTP for treatment. As a result, an increase in pumping from the Baden SPS has the potential to increase peak flows received at both the Morningside SPS and the New Hamburg WWTP.

4.14.4 Morningside SPS

The Morningside SPS is situated within the Morningside Retirement Community located southeast of Morningside Circle West. The pumping station collects the wastewater from the communities of Baden and New Hamburg and pumps it directly via twin 300 mm forcemains into the New Hamburg WWTP for treatment. The Morningside pumping station is the sole collection point for all wastewater flows to the WWTP. The pumping station is operated under MOECC ECA No. 9998-A35NNL.

The Morningside SPS is currently equipped with four 87.5 L/s submersible pumps (3 duty and 1 standby). Three of the existing pumps are the original Flygt CP3300 model with a 290 mm impeller diameter and the fourth pump was replaced with the Flygt NP 3301 model with a 330 mm impeller diameter in 2015. According to the Morningside SPS Capacity Assessment Report (Stantec, 2017), the firm capacity of the station is 248 L/s based on the pump and system curves with three pumps operating, two forcemains in service, and a forcemain C-factor of 130.

The original preliminary design for the station identified that the firm capacity of the station could be increased to 323 L/s by upgrading the impellers on the existing Flygt CP3300 pumps, without the need for any electrical upgrades (Stanley, 1998).

The current peak wet weather discharge flow for the station is 206 L/s observed on June 9, 2010, which is approximately 80% of the station's firm capacity. Projected 2051 PWWF for the station is 272 L/s. Therefore, the existing station does not have sufficient capacity for the planning period.

When reviewing flow projection information, it is important to note that the Morningside SPS conveys all flow to the New Hamburg WWTP. Therefore, the downstream requirements of the plant must be considered when determining when to increase capacity at the Morningside SPS.

The New Hamburg WWTP is in the process of an expansion to increase the rated ADF capacity to 6,900 m³/d with a design PIF of 30,360 m³/d (350 L/s) (HMM, 2015). The existing Morningside station does not have sufficient capacity to handle the expanded design PIF of the New Hamburg WWTP. Replacement of the pump impellers at the Morningside SPS could theoretically increase the overall pump capacity to 323 L/s, however, further upgrades would be required to increase the firm capacity to 350 L/s to match the expanded plant rated treatment capacity.

The Region has recently completed a capacity assessment of the Morningside SPS. Phasing of upgrades to the station have been recommended, as follows (Stantec, February 2017):

- ✦ When replacing the existing pumps due to their condition, consider increasing the rated capacity at the outset to achieve the combined pumping capacity of 290 L/s.
- ✦ In the long-term, a pumping capacity of up to 350 L/s can be obtained with upgrades to the pump impellers. Additional electrical upgrades will be required for this option due to the increase in pump horsepower.

Recommendations for the capacity at the Morningside SPS should be confirmed based on the preferred strategy for the Baden SPS. As noted in Section 4.14.3, an increase in pumping from the Baden SPS has the potential to increase the peak flows received at the Morningside SPS.

4.14.5 Rose Street SPS

The Rose Street SPS is located at the intersection of Rose Street and Water Street in Ayr. The Rose Street SPS receives all of the wastewater flows from the Village of Ayr and pumps it directly into the Ayr WWTP for treatment.

The Rose Street SPS is equipped with three 47 L/s raw sewage pumps that pump all wastewater into two available forcemains, one 200 mm in diameter, and the other 250 mm. Historically, only one forcemain is normally in service to maintain scouring

velocities. The firm capacity of the station is estimated at 80 L/s with two pumps operating through only the smaller 200 mm forcemain (XCG, 2012).

The current peak wet weather discharge flow for the station is 38 L/s observed on June 14, 2013, which is approximately 50% of the station's firm capacity. Projected PWWF for the station is 56 L/s, which is well below the firm capacity of the station. Therefore, the existing station has sufficient capacity for the planning period.

4.14.6 Ayr SPS

The Ayr SPS is a sewage pumping station recently constructed near the northeast corner of Swan Street and Brant Waterloo Road, to service new development in the southern end of the Village of Ayr, Township of North Dumfries. The Ayr SPS will directly discharge to the Ayr WWTP, along with the Rose Street SPS.

The Ayr SPS will be constructed in two phases, with a firm capacity of 46 L/s for Phase 1 and 84 L/s for Phase 2 (GM BluePlan, 2016). Phase 1 was recently constructed, which includes the installation of two pumps (one duty, one standby, each rated 46 L/s) to meet the Phase 1 flow requirements, with provision to accommodate future Phase 2 flows. Once the population has grown to the point that Phase 1 flow projections are close to being exceeded, upgrades to the station will be required, including one additional pump and a second forcemain (Blue Plan, 2016).

With the construction of the Ayr SPS, the Ayr WWTP will have two SPSs (i.e. Rose St. and Ayr SPSs) that convey all flows from the community directly to the plant. Therefore, the future capacity requirements will need to consider both flow projections for the catchment areas and SPS operating strategies with respect to the downstream plant peak flow capacity.

4.14.7 Nith River Way SPS

The Nith River Way SPS is located on Nith River Way in the Village of Ayr. The station receives wastewater from a small service area, which includes Seyler Street, Nith River Way, Robson Street, Simone Place, Douglas Street and Broom Street.

The Nith River Way SPS is equipped with two 3.9 L/s submersible pumps that pump into a 150 mm diameter forcemain that discharges into the Broom Street sanitary sewer. The firm capacity of the Nith River Way SPS is estimated to be 3.9 L/s based on one pump out of service (Stantec, 2014).

Nith River Way SPS is a dedicated development SPS. As a result, an increase in flows is not expected for this station.

4.14.8 Summary

The capacity assessment results for the seven (7) SPSs are summarized below in Table 28.

Table 28 Capacity Assessment of SPSs

SPS	Firm Capacity (L/s)	Current PWWF (L/s) (% of Firm Capacity)	Projected 2051 PWWF (L/s)	Recommendations
Bridgeport	136	85 (60%) ⁽¹⁾	114	Expansion not required
Spring Valley	245	207 (85%) ⁽¹⁾	252	Minor increase in station capacity, to be phased with asset renewal projects
Baden	189	185 (98%) ⁽²⁾	226	Review options to increase the SPS capacity to handle the 2051 PWWF
Morningside	262.5	206 (80%) ⁽²⁾	272	Review options to provide additional capacity, with consideration for Baden SPS recommendations and the peak flow capacity of the New Hamburg WWTP.
Rose Street	80	38 (50%) ⁽²⁾	56	Expansion not required
Ayr	46	N/A ⁽³⁾	41	Expansion not required
Nith River Way	N/A	<3.9 (<100%)	N/A ⁽⁴⁾	Expansion not required

Notes:

1. Peak wet weather flow into the station based on historic influent flow monitoring data.
2. Peak wet weather discharge flow for the station based on historic discharge flow monitoring data.
3. The Ayr SPS is a proposed SPS and there is no current flow data available.
4. Nith River Way SPS is a dedicated development SPS, and there is no projected growth.

5. East Side Land Servicing

5.1 Overview

The ESL describes the developable area on the east side of the Grand River, surrounding the Waterloo Regional Airport. The area encompasses approximately 4,000 hectares of land in the Township of Woolwich, the City of Cambridge, and the City of Kitchener. It is anticipated to be predominately a mixture of ICI with some residential land use.

Within the developable portion of the ESL, there are two areas that are currently served by the Region's WWTPs. The northern area of ESL (Hopewell Heights Subdivision and Countryside Village Subdivision – approximately 385 hectares), is serviced by the Kitchener WWTP through the Victoria Road sanitary sewer. The southern area of the ESL (Industrial Park area – approximately 632 hectares) is serviced by the Preston WWTP. The remainder of the ESL is currently unserved.

The population and employment projections for the ESL are based on information provided by the Region's Planning Department, as summarized in Table 29.

Table 29 East Side Lands Development Population Projections

East Side Lands	2016	2021	2026	2031	2036	2041	2046	2051	Beyond 2051
Population	628	2,661	4,584	5,753	7,413	9,239	12,182	14,297	45,733

Several planning studies have provided input on sanitary servicing for the ESL including the 2007 WWTMP (Earth Tech, 2007) and the recent ESL Sanitary Servicing Class EA (Associated Engineering, ongoing). The following are recommendations from these studies:

- + 2007 WWTMP
 - Transfer IRSA flows from the Preston WWTP to the Galt WWTP to release capacity at the Preston WWTP
 - Service the south area of the ESL in the short-term using the available capacity at the Preston WWTP
 - Service the entire ESL long-term using the Kitchener WWTP, a larger plant with more available capacity.
- + ESL Sanitary Servicing Class EA

- Provide long-term servicing by constructing a gravity trunk sewer with a dedicated service bridge over the Grand River to divert flows from the southern area of the ESLs to the Kitchener WWTP

The following sections describe the interim and long-term servicing alternatives for the ESL.

5.2 Interim Servicing at Preston WWTP

The Fountain Street Trunk Sewer conveys flows from areas in the City of Cambridge in the neighbourhood of Maple Grove Road to south of Highway 401 and ultimately to the Preston WWTP. The interim strategy during the early development phase for the wastewater servicing of the ESL includes sending flows to the Preston WWTP for treatment via the Fountain Street Trunk Sewer (Earth Tech, 2007), as the Preston WWTP has available capacity with the diversion of IRSA flows from the Preston WWTP to the Galt WWTP.

Based on available data from the City of Cambridge, and the availability of hydraulic models for the service area, CIMA+ assessed the existing sewer capacity for interim servicing of the ESL development areas and analyzed the potential impact of the additional flows. Furthermore, the review identified the triggers for implementing the long-term strategy for connecting the ESL to the Kitchener WWTP.

5.2.1 Collection System Capacity Assessment

A capacity assessment was conducted for the Fountain Street Trunk Sewer based on the sanitary hydraulic model developed for the City of Cambridge Sanitary Servicing Master Plan (AECOM, 2012). Modeling results were used to identify potential constraints in the sewer network capacity when conveying flows from the ESL to the Preston WWTP.

Potential bottlenecks were identified for the following locations along the Fountain Street Trunk Sewer, as illustrated in Figure 14:

- ✦ Fountain Street north, north of Highway 401 (model pipe ID SP11345) – Sewer capacity of 531 L/s;
- ✦ Fountain Street south, south of King St W. (model pipe ID SP11060) – Sewer capacity of 894 L/s; and

- + Upstream of the river siphon, south of the intersection of Shantz Hill Rd. and Fountain Street south (model pipe ID SP11249) – Sewer capacity estimated between 600 L/s and 890 L/s (governed by downstream siphon)

The Preston WWTP has an average day rated capacity of 194 L/s, and a peak flow capacity of 498 L/s. As noted above, modeling results indicate that all of the potential bottleneck locations have sufficient capacity to convey flows greater than the treatment plant peak flow capacity. Therefore, the trigger for implementing the long-term servicing solution for the ESL will be determined based on the capacity of the Preston WWTP, rather than the capacity of the collection system.

A sensitivity analysis was completed to assess the potential for peak flows in the collection system to become the trigger for the long-term servicing solution. The analysis indicated that peak flows in the Fountain St Trunk can be as high as 30% greater than modeled flows before the collection system would become a constraint.

More details about the collection system capacity assessment for the interim servicing of ESL at the Preston WWTP are available in TM8 – Capacity Assessment of Fountain Street Trunk Sewer, in Appendix I.

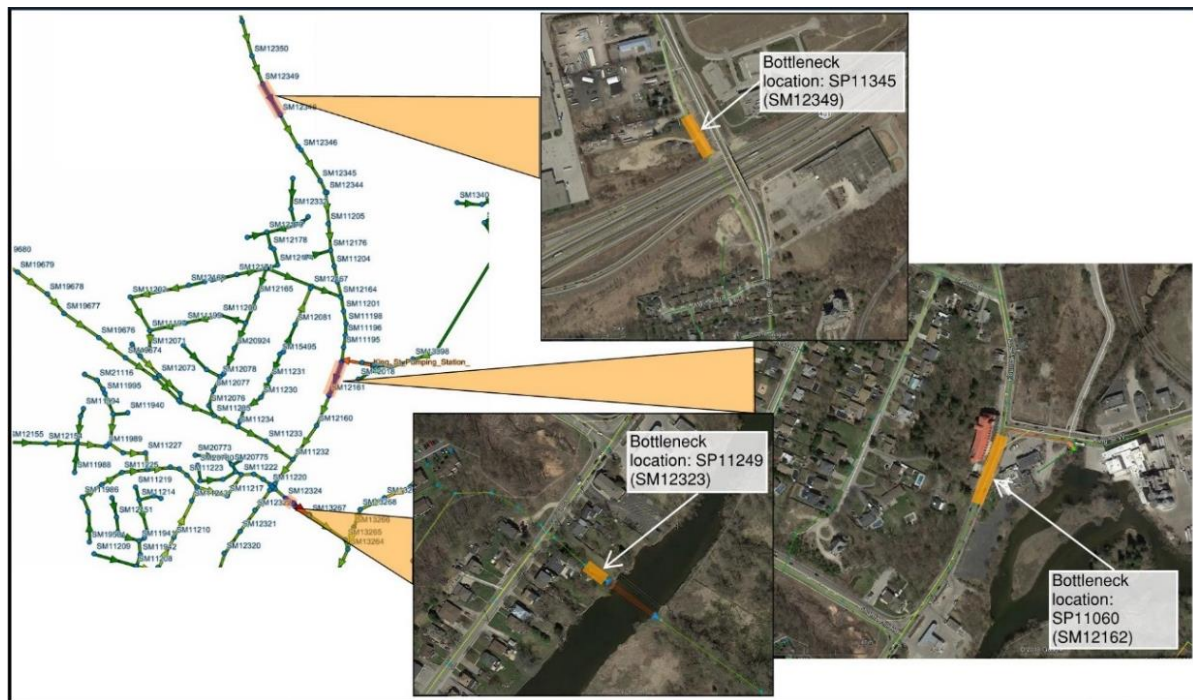


Figure 14 **Locations of Potential Sewer Bottlenecks on Fountain Street**

5.2.2 Preston WWTP Capacity Assessment

A capacity assessment was conducted for the Preston WWTP based on the planning projections developed through the 2018 WWTMP Update (refer to TM1A – WWTP Population and Flow Projections, available in Appendix A), to determine the timing for when the long-term servicing strategy will be needed. Key findings of the assessment include:

- + The average day flow to the Preston WWTP governs the interim servicing capacity for ESL. Overall, the Preston WWTP has sufficient average day rated capacity (194 L/s or 16,860 m³/d) to manage projected population growth together with the ESL growth until approximately 2041.
- + The peak flow capacity of the Preston WWTP (498 L/s or 43,000 m³/d) has sufficient capacity to manage the projected peak flow of 381 L/s to the Preston WWTP in 2041.

In summary, based on current growth projections, the Preston WWTP and the existing collection system can handle the projected flows (average and peak) associated with planned growth within the Preston WWTP catchment area and ESL development until approximately 2041.

Long-term, flows are to be diverted to the Kitchener WWTP, a larger plant with more available capacity to service the ultimate growth of the ESL. The construction of the diversion to the Kitchener WWTP is to be phased to ensure the Preston WWTP continues to operate within the approved rated capacity. After the long-term servicing solution of conveying flows to the Kitchener WWTP has been constructed, the excess capacity available in the Fountain Street trunk and at the Preston WWTP will be restored.

It is important to note that if development of ESL progresses faster than projected, the long-term servicing solution of conveying flows to the Kitchener WWTP should be implemented earlier. Flows to the WWTPs are reviewed annually as part of the Region's WWWMRs, and the WWTMP is typically updated every 5 to 10 years to confirm recommendations and proposed timing.

5.3 Long-term Servicing at Kitchener WWTP

The long-term servicing strategy to convey flows from the ESLs to the Kitchener WWTP has been identified as gravity sewers without the need for a pumping station,

as outlined in the East Side Lands Sanitary Servicing Class EA (Associated Engineering, ongoing). The gravity sewer begins at a location north of Freeport Creek, is aligned through the Deer Ridge subdivision, and ends at the inlet of the Kitchener WWTP. A dedicated service bridge for the sewer pipe is proposed to cross above the Grand River. When the existing infrastructure at the Preston WWTP is nearing capacity, a new gravity trunk sewer will be constructed to direct flows from the southern area of the ESL to the Kitchener WWTP.

5.4 Summary and Recommendations

Based on current growth projections, Preston WWTP has sufficient average day and peak rated capacity to manage projected population growth within the Preston WWTP catchment area together with the ESL growth until approximately 2041. Long-term, flows are to be diverted to the Kitchener WWTP. The construction of a diversion to the Kitchener WWTP is to be phased to ensure the Preston WWTP continues to operate within the approved rated capacity. After this long-term servicing solution has been constructed, capacity in the Fountain St trunk and at the Preston WWTP will be restored.

6. Alternatives Evaluation

As part of the 2018 WWTMP Update, options were developed to accommodate growth, meet level of treatment needs, enhance operations and reduce energy. Plant-specific options were identified, as well as options that would benefit all Regional facilities. A preliminary screening was completed to identify a short list of alternatives to be further developed and evaluated.

In order to develop a robust long-term servicing plan for the Region's wastewater treatment plants and pumping stations, both infrastructure options and non-infrastructure opportunities were identified for facilities as described below:

- ✦ Infrastructure options are approaches that are more widely accepted by the industry and there is a high level of confidence that approvals could be obtained (such as expansions to existing processes).
- ✦ Non-infrastructure opportunities represent new approaches and will require additional studies and consultation to confirm feasibility and approvals. It can be noted that some new minor infrastructure may be required for non-infrastructure opportunities; however, these opportunities are more focused on changes to operations or implementing new programs to achieve objectives.

An evaluation framework and criteria were developed and confirmed through the Steering Committee and public review to evaluate the short-listed alternatives. The evaluation framework and criteria were used to identify alternatives that meet short and long term requirements, assess impacts on the natural environment, undertake financial evaluations, confirm public acceptance, and identify social and technical/operational issues to be addressed.

To ensure the Region has a fully funded and feasible plan in place following the completion of the 2018 WWTMP Update, infrastructure options were recommended as the preferred option for each facility to meet growth and level of treatment needs, with non-infrastructure opportunities noted where available for further investigation. In addition to facility specific recommendations, regional wastewater options including infiltration/inflow reduction, watershed management, water re-use, resource recovery, industrial pre-treatment and asset management, were also reviewed.

Depending on the time between implementing a project and the completion of the 2018 WWTMP Update, the state of the industry should be reviewed as part of an

upgrade or expansion. This review is recommended to determine if new or innovative technologies have been developed since the completion of the WWTMP that may provide a benefit to the Region, and account for potential changes to regulatory requirements.

6.1 Evaluation Methodology and Criteria

The process for the 2018 WWTMP Update is based on the same evaluation methodology used in the 2007 WWTMP, which is a decision-making model centered on a multi-criteria analysis (MCA). The MCA provides a structured approach to determine overall benefits among alternative options, where the options accomplish several objectives. This evaluation methodology requires specification of desirable objectives and identification of corresponding indicators, which are then used to measure/assess the ability of each alternative option to meet a specific objective. Additional details on the evaluation methodology are available in TM5 – Evaluation Methodology, in Appendix F.

The evaluation approach follows a typical evaluation of impacts to a wide range of criteria that include natural, socio/cultural, financial and technical environments, as well as legal/jurisdictional and technical factors. The criteria used in the 2007 WWTMP were used as a basis for this WWTMP Update, with some modifications to enhance the criteria and address more recent factors such as climate change and GHG reductions. The decision-making criteria and rationale is summarized in Table 30.

Based on the evaluation methodology above, an evaluation matrix was prepared describing the specific advantages and disadvantages that each alternative option offers for each criterion under consideration. For each alternative solution/strategy, information is provided to identify advantages and disadvantages of each alternative option with respect to the evaluation criteria. In this respect, comparisons and trade-offs can be made between alternatives. Within the evaluation matrix, scores are assigned as follows:

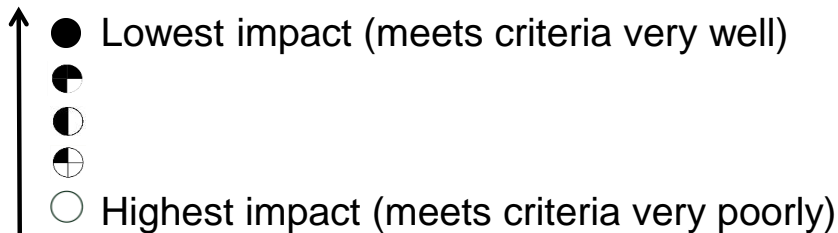


Table 30 Decision-Making Criteria and Rationale

Category	Criteria	Rationale and Measures
Environmental Factors	Surface Water Protection	Maximize reliability in achieving effluent quality limits Protect fisheries and aquatic health Use a watershed approach to protect surface waters
	Wells and Aquifer Protection	Protect groundwater and respect Clean Water Act requirements
	Protection of Natural Features	Minimize the potential impact from construction and operation to existing terrestrial habitats/features, vegetation, wetlands, and woodlots Protect Greenlands Network, identified in Regional Official Plan (ROP) to include environmental features, ecological buffers, and linkages
	Climate Change	Resiliency to extreme conditions
Social Factors	Health and Safety	Minimize the potential risk to public health and safety, particularly on downstream users (including for recreation and tourism)
	Short and Long-term Growth	Minimize potential negative effects on short term and long-term community growth and development Meet Region's growth objectives outlined in ROP
	Land Use	Maximize land use to preserve site area for any future requirements and minimize construction beyond the current footprint
	Community Impacts (Odour, Noise, Truck Traffic)	Minimize odours, noise and truck traffic affecting the community during construction and plant operation

Category	Criteria	Rationale and Measures
	Cultural and Archaeological Heritage	Minimize potential impact to historical, cultural, archaeological and architecturally significant features
	First Nations Considerations	Minimize the potential impact to First Nations communities
Legal/ Jurisdictional Factors	Approvals	Minimize the complexity and time spent to obtain approvals considering current and future regulatory environment
	Land Requirements	Potential need to acquire land for additional treatment works and ownership requirements
Technical Factors	Energy Use and Greenhouse Gas Generation	Minimize GHG emissions, net energy use, and sludge volumes Maximize biogas generation for cogeneration and biofuel opportunities
	Constructability	Flexibility of scheduling works is of key concern due to uncertainty in timing of growth Minimize complex construction and maximize ability to maintain adequate treatment during construction
	Optimization of Existing Infrastructure	Optimize existing infrastructure investment and treatment capacity
	Innovation	Maximize use of innovative technologies and processes to enhance level of treatment or treatment efficiency Resource recovery
	Security, Reliability and Robustness	Lesser likelihood of process upset or mechanical breakdown Ability to meet performance objectives under a range of conditions
Financial Factors	Life Cycle Cost	Minimize capital, operation and maintenance (life cycle) costs over the planning period
	Cost to Ratepayers	Impact to existing ratepayers for user rates
	Financial Sustainability	Balance infrastructure needs with ability to pay (user rates and development charges)

6.2 Regional Wastewater Options

Regional wastewater options do not form standalone solutions for any facility, but are a component of any option. From a Regional perspective, these approaches offer benefits from either environmental, social, technical or economic perspectives. The approaches include I/I reduction, watershed management, water re-use, resource recovery, industrial pre-treatment, and asset management. These options are further described in the following sections, with additional details available in TM6 – Identification and Screening of Alternative Liquid Treatment Options, and TM10 – Development and Evaluation of Short-Listed Options in Appendix G and Appendix L, respectively.

6.2.1 Inflow/Infiltration Reduction

I/I can be a significant issue within wastewater collection systems and lead to high flows being conveyed to the treatment plant, which has many unit processes limited by peak flows (including headworks, clarifiers, filtration, disinfection). I/I control is important to allow the treatment plant to operate properly, to alleviate any concerns with plant bypasses due to high flows, as well as enable the accurate planning of upgrades or expansions to the treatment plants.

There are challenges with the implementation of I/I reduction programs due to the two-tiered system whereby local municipalities are responsible for collection systems and the Region is responsible for treatment. However, a number of initiatives have been undertaken, some through the partnership of the Region and local municipalities, to identify and remedy I/I issues.

It is recognized that finding and addressing the causes of I/I can be difficult, particularly if the issue relates to private residences. A key approach for I/I reduction should include a public awareness campaign to increase the level of understanding of the impacts of foundation drain and downspout connection to the collection system.

Elevated I/I has been identified within the following WWTP service areas:

- + St Jacobs
- + Elmira
- + Wellesley
- + Ayr

For the above listed service areas, I/I reduction should form an integral part of any approach for the associated treatment plant; however, it will not serve as a stand-alone solution.

6.2.2 Watershed Management

The Grand River watershed drains an area of 6,800 square kilometers and there are 39 municipalities (Regional, Local and single tier), as well as two First Nations, that form part of the watershed. It has long been recognized that management of the watershed must be a collaborative effort by all stakeholders.

Since the completion of the 2007 WWTMP, the GRCA, watershed municipalities, provincial governments, federal departments, and First Nations came together in 2009 to review and update the Grand River Watershed Water Management Plan (WMP) to ensure a healthy river system and linkage to Lake Erie, secure water supplies, manage flood risks and deal with climate change (GRCA, 2014).

The Region has been a key stakeholder in the development of the 2014 WMP. Another key initiative that the Region has undertaken since the completion of the 2007 WWTMP is the SWQMP. The SWQMP focuses on the impacts of ten of the Region's WWTPs on their respective receiving waters. This program provides evidence needed to obtain approvals, provides sufficient understanding to effectively evaluate alternatives during Master Plan updates and gives adequate evidence to demonstrate the degree of receiver improvement resulting from implementation of WWTP upgrades and other projects intended to improve receiver quality. Collaboration with the University of Waterloo (UW) has led to findings that upgrades to the Region's WWTPs are making a significant difference to the health of the fish in the Grand River (Servos, 2017).

6.2.3 Water Re-use

Re-use of treated wastewater should be considered to reduce potable water consumption where possible, feasible and practical. Wastewater re-use opportunities present a number of challenges such as current regulation requirements and codes (i.e. Ontario Building Code, Plumbing Code) regarding water use and plumbing restrictions, the Region's northern climate (resulting in seasonal applications and need for storage for some re-use options), and the two-tiered system whereby the Region is responsible for treatment and the area municipalities are responsible for

collection systems (for the most part). However, there are also potential advantages such as the reduction in treatment requirements, reduced loading to the receiving water and the decrease in potable water use for industrial or agricultural purposes.

There are opportunities to investigate water re-use within Waterloo Region, particularly in the context of the development of the ESL. The ESL have been identified primarily for employment development and water re-use may be particularly beneficial for new potential industries. The ESL also provide a good opportunity for water re-use as there are far fewer challenges to implementing a water re-use scheme within newly developed areas as compared to retrofitting existing infrastructure.

6.2.4 Resource Recovery

Wastewater has a number of constituents that can be considered as a resource for recovery. Key items for consideration are nutrients (nitrogen and phosphorus) for fertilizer production and biopolymers, recovery of valuable trace metals or using digester gas to produce methanol or ammonia. There are also opportunities for beneficial use of biosolids (i.e., fuel source, additive for brick manufacturing, etc.), which are considered as part of the parallel Biosolids Master Plan.

The key factors for consideration include technologies available to recover resources from wastewater treatment, their operating costs and identifying markets for the resources. Wastewater resource recovery is still an emerging field and to date most of the developed technologies have focused around nutrient recovery. However, the majority of the WWTP infrastructure in the Region is based on the addition of metal salts to precipitate phosphorus and current nutrient recovery technologies (i.e., OSTARA® or similar) and eventually biological phosphorus removal (and associated technologies) would need to be evaluated in more detail in terms of their economic viability.

Research on new technologies for resource recovery is on-going and should be reviewed at the time of any upgrades and as part of future Master Plan updates for future applicability to Region facilities. In consideration of the high level of treatment and cost of nutrient removal required at most Region plants, technologies that can provide phosphorus and/or nitrogen recovery could provide immediate benefit in reduced WWTP operating costs and nutrient loadings to the receiving water. As an example of developing technologies, high-rate algae production is being developed

to recover phosphorus with the benefits of lower loadings to the receiving waterbody, reduced chemical costs and opportunities for biopolymer production. This technology has been implemented in WWTPs in the United States in Perrysburg, Ohio, Millbury, Massachusetts, and Missoula, Montana, with similar climates to Southern Ontario.

6.2.5 Industrial Pre-treatment

Many industries discharge their wastewater to the collection system for treatment at WWTPs. A discharger in contravention of the Sewer-Use By-Law limits may attain compliance by either installing pretreatment, implementing process control measures, hauling the non-compliant material for off-site treatment or, if the option is available, entering into a surcharge agreement with the Region. Under a surcharge agreement, the Region treats this wastewater up to a predetermined limit for an additional fee.

Surcharge Agreements are only available for four substances because these are treated by the Region's wastewater treatment plants without causing operational problems if present above the Sewer-Use By-Law limits. These are: suspended solids, biochemical oxygen demand, total kjeldahl nitrogen, and phosphorus. Surcharge Agreements are only considered if there is sufficient treatment capacity at the receiving wastewater treatment plant.

While local industries are an important part of the economy, a single surcharge agreement can use upwards of 15% of a wastewater treatment plant's capacity. Pre-treatment at the source can significantly reduce flow and/or loading. A balance is therefore necessary to ensure future strategies are sustainable and continue to retain/attract local industries.

6.2.6 Asset Management

The Region has significant investments in wastewater infrastructure across the Region. In order to provide continued reliable service into the future, equipment requires both on-going maintenance and replacement over the life-cycle. In recognition of the value of existing infrastructure, the Region has implemented a comprehensive asset management program for all of its facilities to best manage on-going maintenance and plan for asset renewal. The Region's Wastewater 10-year Capital Program includes a section for infrastructure renewal, which currently accounts for 20% of the budget.

As assets near the end of their lifecycle, consideration should be made for newer technologies that may provide value to the Region based on factors such as reduced energy consumption, lower greenhouse gas emissions, improved operating performance, and lower operating costs.

6.3 Growth Servicing and Level of Treatment Alternatives

Alternatives have been identified to address the opportunities/constraints to accommodate for growth and effluent quality at the ten (10) larger WWTPs. It can be noted that the three (3) smaller treatment plants (Foxboro Green, Conestogo and Alt-Heidelberg) are communal treatment plants servicing only a single residential development and do not have future growth needs. As a result, specific alternatives have not been evaluated for these facilities. There may be opportunities for operational improvements at these smaller plants, however these would be implemented on an asset renewal basis.

The Region has invested significant funds in wastewater infrastructure and any plan must ensure that this infrastructure is fully utilized and optimized to make use of this investment. All options consider the infrastructure currently in place within a treatment plant and consider the compatibility of any new processes or technologies with this existing infrastructure. As described in Section 6, both infrastructure options and non-infrastructure opportunities were identified for each facility.

A number of key opportunities were considered to provide capacity for growth, including:

+ Infrastructure Options

- Expansion with Existing Treatment Technology - WWTPs are expanded with the same technologies that are currently used at the plant.
- Expansion with New Treatment Technology – new technologies that provide value to the Region are used to provide additional capacity.
- Diversion – wastewater from a plant that has a constraint in capacity is sent to another plant that has available capacity.

+ Non-infrastructure Opportunity

- Expansion by Re-rating – re-rating is used to provide more capacity through changes in existing processes rather than building new

infrastructure. Re-rating provides the opportunity to defer the timing for a physical expansion.

The majority of the level of treatment considerations are related to achieving lower effluent TP concentrations, as phosphorus is a key consideration based on limitations in the receiving water stream and the anticipated Lake Erie targets. The following options were considered to reduce effluent TP:

+ Infrastructure Options

- Optimization of Secondary Treatment – optimized chemical dosing to achieve phosphorus removal targets
- Tertiary Filtration – install new tertiary filters or expand existing tertiary filters at facilities where they are already installed;
- New Phosphorus Removal Technologies – use new technologies that provide value to the Region.

+ Non-infrastructure Opportunities

- Phosphorus Trading – improving treatment at one plant that already has filters to defer upgrades at another plant and reduce the net impact on the receiving waters.
- Phosphorus Off-setting – removing phosphorus from sources that are not treated at the WWTPs (such as storm water or agricultural sources). A higher phosphorus removal is targeted for non-WWTP sources.

Depending on the time between implementing a project and the completion of the 2018 WWTMP Update, the state of the industry should be reviewed as part of an upgrade or expansion. This review is recommended to determine if new or innovative technologies have been developed since the completion of the WWTMP that may provide a benefit to the Region, and account for potential changes to regulatory requirements.

The following sections outline the short-listed alternatives, evaluation process, and preferred option for each WWTP for growth and effluent quality. Additional details on the short-listed options and the evaluation process are provided in TM10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

6.3.1 Waterloo WWTP

The alternatives to address the opportunities/constraints to accommodate for growth and effluent quality at the Waterloo WWP are identified as follows:

- + Growth - Expansion of the plant to a minimum flow of 63,600 m³/d, which includes a 5% safety factor on the projected 2051 flow of 60,500 m³/d.
 - Infrastructure Options
 - o Flow Diversion to Kitchener WWTP. This option diverts flow in excess of the existing rated capacity of the Waterloo WWTP to Kitchener WWTP for treatment.
 - o Conventional Expansion
 - o Expansion Using New Technology (i.e. Granular Sludge or Similar)
 - Non-infrastructure Opportunity
 - o Re-rating
- + Level of Treatment – Phosphorus removal is expected to be required as part of the plant expansion to meet effluent phosphorus targets, and as part of the Lake Erie Basin targets, as discussed in Section 3.3.
 - Infrastructure Option
 - o Phosphorus Removal (New Tertiary Filters). New tertiary filters would be constructed at the Waterloo WWTP.
 - Non-infrastructure Opportunity
 - o Phosphorus Trading with Kitchener WWTP. The Waterloo WWTP would remove phosphorus through optimized chemical dosing and secondary treatment, which would result in a higher effluent TP concentration when compared to tertiary treatment at the Waterloo WWTP. Kitchener WWTP would be required to achieve lower overall effluent TP concentrations to maintain the same net loadings to the Grand River as the phosphorus removal option.

A summary of the evaluation for the Waterloo WWTP strategies of growth and level of treatment alternatives are presented in Table 31 and Table 32, respectively.

Additional details are provided in TM10 - Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 31 Evaluation Summary of Strategies for Growth for the Waterloo WWTP

Strategies for Growth				
Evaluation Category	Infrastructure Options			Non-Infrastructure Opportunity
	Diversion to Kitchener WWTP	Conventional Expansion	Expansion Using New Technology	Capacity Re-rating
Environmental	<ul style="list-style-type: none"> • Potential environmental impact due to upgrades for the collection system (pumping stations, forcemains, and sewers) 	<ul style="list-style-type: none"> • Minimal potential risk as technology is well understood and would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Minimal potential risk as expansion would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Minor potential risk due to operation at higher loading rates
Social	<ul style="list-style-type: none"> • Potential for impacts due to upgrades for the collection system (pumping stations, forcemains, and sewers) 	<ul style="list-style-type: none"> • Largest land use, minimal land for future expansion • Potential for construction impacts 	<ul style="list-style-type: none"> • Some potential for construction impacts • Preserves space for future requirements 	<ul style="list-style-type: none"> • Minimal social impacts as this would not require significant construction
Legal/Jurisdictional	<ul style="list-style-type: none"> • Potential for easements for upgrades to collection system 	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Pilot testing may be required for approval 	<ul style="list-style-type: none"> • Stress testing required prior to approval
Technical	<ul style="list-style-type: none"> • Makes use of existing capacity at Kitchener WWTP • Flows that could be diverted are 	<ul style="list-style-type: none"> • Does not make use of existing infrastructure 	<ul style="list-style-type: none"> • Energy savings • Limited full-scale experience 	<ul style="list-style-type: none"> • Optimizes existing infrastructure. • Less robust due to higher loading rates

Strategies for Growth				
Evaluation Category	Infrastructure Options			Non-Infrastructure Opportunity
	Diversion to Kitchener WWTP	Conventional Expansion	Expansion Using New Technology	Capacity Re-rating
	limited based on the collection system configuration			
Financial	<ul style="list-style-type: none"> • Low to moderate capital cost • Moderate operating cost • Low to moderate lifecycle cost 	<ul style="list-style-type: none"> • Highest capital cost • Moderate operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Moderate to high capital cost • Moderate operating cost • Moderate to high lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Moderate operating cost • Lowest lifecycle cost

Table 32 Evaluation Summary of Level of Treatment Strategies for the Waterloo WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Tertiary Filters)	Phosphorus Trading with Kitchener WWTP
Environmental	<ul style="list-style-type: none"> • Minor potential impacts associated with construction • Tertiary filters would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Potential for significant environmental impacts to the reach of Grand River between Waterloo and Kitchener WWTPs • Increased loadings not permitted for Policy 2 receiver
Social	<ul style="list-style-type: none"> • Minor potential impacts due to construction 	<ul style="list-style-type: none"> • Potential risk related to extremely low TP limits at Kitchener WWTP and risk to achieve these on monthly basis (0.11 mg/L TP) • Little flexibility to meet future growth needs with this option
Legal/ Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts as infrastructure would be 	<ul style="list-style-type: none"> • Extensive consultation required with MOECC and GRCA

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Tertiary Filters)	Phosphorus Trading with Kitchener WWTP
	within existing site footprint and technology is well understood	<ul style="list-style-type: none"> • Approvals not likely based on increased loadings in the reaches of the Grand River between Waterloo and Kitchener WWTPs
Technical	<ul style="list-style-type: none"> • Some additional energy use and GHG emissions for new tertiary treatment facility • Does not utilize existing infrastructure 	<ul style="list-style-type: none"> • Minimal additional energy use or GHGs since tertiary treatment existing at Kitchener WWTP • Utilizes existing infrastructure • Potential impact on water quality for Mannheim WTP
Financial	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost

Based on the evaluation, the following are the preferred infrastructure alternatives, with the key considerations, together with any non-infrastructure opportunities recommended for further investigation:

Growth

- + Preferred Infrastructure Option: Expansion Using New Technology (Granular Sludge or Similar)
 - Significant potential for energy savings
 - Can be incorporated into existing infrastructure
 - Preserves site space for future requirements
 - Lowest annual operating cost
 - Pilot testing may be required for approval
- + Non-infrastructure Opportunity: Re-rating of the Waterloo WWTP (pending more detailed study to confirm feasibility)
 - Lowest cost alternative
 - Utilizes existing infrastructure

- Could accommodate small capacity increase required within the planning period
- Minimal environmental and social impacts due to reduced construction required for implementation.
- Requires re-rating study and approval by MOECC prior to implementation

Level of Treatment

- + Preferred Infrastructure Option - Phosphorus Removal (New Tertiary Filters)
 - Minimal environmental impacts since tertiary filtration is a well understood process able to meet phosphorus removal targets to the Grand River
 - Reliable treatment technology
 - Minimal social impacts with construction restricted to existing treatment plant site, but does require site space

6.3.2 Preston WWTP

The alternatives to address the opportunities/constraints to accommodate future level of treatment at the Preston WWTP are identified as follows:

- + Level of Treatment: Phosphorus removal is expected to be required to meet Lake Erie effluent phosphorus targets.
 - Infrastructure Option
 - o Phosphorus Removal (Optimization of Secondary Treatment)
 - Non-infrastructure Opportunity
 - o Phosphorus Off-Setting. Funding for non-point source controls to offset higher loadings at Preston WWTP

A summary of the evaluation for the Preston WWTP strategies related to level of treatment alternatives is provided in Table 33. Additional details are provided in TM10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 33 Evaluation Summary of Level of Treatment Strategies for the Preston WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Optimization of Secondary Treatment) ⁽¹⁾	Phosphorus Off-Setting
Environmental	<ul style="list-style-type: none"> • No anticipated impacts as Lake Erie phosphorus target less than of 0.4 mg/L already being achieved 	<ul style="list-style-type: none"> • No anticipated impacts
Social	<ul style="list-style-type: none"> • No construction required • Site space preserved for future requirements 	<ul style="list-style-type: none"> • Limited potential impacts due to construction of non-point source controls
Legal/ Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Significant effort required for approval, including consultation with MOECC and GRCA
Technical	<ul style="list-style-type: none"> • No change in energy use or GHG emissions 	<ul style="list-style-type: none"> • Innovative method to achieve overall watershed improvements
Financial	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost 	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost

Note:

1. The Preston WWTP is currently achieving less than 0.4 mg/L TP, so there is no anticipated change to operating costs associated with this option.

Based on the evaluation, the following is the preferred infrastructure alternative, with key considerations:

Level of Treatment

- + Preferred Infrastructure Option: Phosphorus Removal (Optimization of Secondary Treatment) at Preston WWTP
 - Lowest cost alternative

- Utilizes existing secondary treatment and chemical dosing infrastructure already available at the Preston WWTP
- Preserves site space for future requirements
- Minimal social impacts with no construction required.

Non-Infrastructure opportunities were not recommended for the Preston WWTP.

6.3.3 Hespeler WWTP

Hespeler WWTP will require expansion by the year 2047 to accommodate the projected 2051 flow of 9,900 m³/d and provide year-round nitrification. The alternatives to address the opportunities/constraints to accommodate for growth and effluent quality at the Hespeler WWP are identified as follows:

- + Growth - Expansion to a minimum flow of 10,400 m³/d, which includes a 5% safety factor on the projected 2051 flow of 9,900 m³/d
 - Infrastructure Options
 - o Conventional Expansion
 - o Expansion Using New Technology (MABR or Similar)
- + Level of Treatment - Phosphorus removal is expected to be required as part of the plant expansion and Lake Erie effluent phosphorus target requirements. However, the primary driver for the phosphorus removal for Hespeler WWTP is the Lake Erie targets, as this is expected to be required prior to the need for additional plant capacity.
 - Infrastructure Option
 - o Phosphorus Removal (Optimization of Secondary Treatment)
 - Non-infrastructure Opportunity
 - o Phosphorus Off-Setting. Funding for non-point source controls to offset higher loadings at Hespeler WWTP

A summary of the evaluation for the Hespeler WWTP strategies of growth and level of treatment alternatives are presented in Table 34 and Table 35, respectively. Additional details are provided in TM10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 34 Evaluation Summary of Strategies for Growth for the Hespeler WWTP

Strategies for Growth		
Evaluation Category	Infrastructure Options	
	Conventional Expansion	Expansion Using New Technology
Environmental	<ul style="list-style-type: none"> • Minimal potential risk as technology is well understood and would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Minimal potential risk as expansion would be designed to meet treatment requirement
Social	<ul style="list-style-type: none"> • Largest land use, minimal land for future expansion • Potential for construction impacts 	<ul style="list-style-type: none"> • Some potential for construction impacts • Preserves space for future requirements
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Pilot testing may be required for approval
Technical	<ul style="list-style-type: none"> • Does not make use of existing infrastructure 	<ul style="list-style-type: none"> • Energy savings • Limited full-scale experience
Financial	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost

Table 35 Evaluation Summary of Level of Treatment Strategies for the Hespeler WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Optimization of Secondary Treatment)	Phosphorus Off-Setting
Environmental	<ul style="list-style-type: none"> • No anticipated impacts as phosphorus removal through improved chemical dosing is well understood and protective of environment 	<ul style="list-style-type: none"> • No anticipated impacts as overall improvement to environment from non-point sources
Social	<ul style="list-style-type: none"> • Minor impacts due to upgrades to chemical mixing and dosing system • Site space preserved for future requirements 	<ul style="list-style-type: none"> • Limited potential impacts due to construction of non-point source controls
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts as the approach would use existing equipment and is well understood. 	<ul style="list-style-type: none"> • Significant effort required for approval

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Optimization of Secondary Treatment)	Phosphorus Off-Setting
		<ul style="list-style-type: none"> • Extensive consultation required with MOECC and GRCA
Technical	<ul style="list-style-type: none"> • Minimal additional energy use or GHG emissions for chemical dosing upgrades 	<ul style="list-style-type: none"> • Innovative method to achieve overall watershed improvements
Financial	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost 	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost

Based on the evaluation, the following are the preferred infrastructure alternatives, with key considerations:

Growth

- + Preferred Infrastructure Option: Expansion Using New Technology (MABR or Similar)
 - Lowest cost alternative
 - New, innovative technology
 - Small footprint preserving space for future expansion
 - Provides environmental benefits due to energy savings

It is important to note that based on the expected potential deferral for a capacity expansion, as identified in this 2018 WWTMP Update, it is expected that short-term upgrades will also be required to provide nitrification as per the ACS conducted in 2014, with a proposed ECA objective of 2 and 5 mg/L for NH₃-N (summer and winter, respectively) (Stantec, 2014).

Level of Treatment

- + Preferred Infrastructure Option: Phosphorus Removal (Optimization of Secondary Treatment)
 - Lowest cost alternative through optimized chemical dosing

- Reduced impact on site footprint to allow space for future expansion requirements
- High phosphorus load reduction challenging to achieve with phosphorus off-setting
- Construction impacts limited to Hespeler WWTP site.

Non-infrastructure opportunities were not recommended for the Hespeler WWTP.

6.3.4 St Jacobs WWTP

The alternatives to address the opportunities/constraints to accommodate growth and level of treatment at the St Jacobs WWTP are identified as follows:

- + Growth – Expansion to a minimum flow of 1,600 m³/d, which includes a 5% safety factor on the projected 2051 flow of 1,530 m³/d
 - Infrastructure Options
 - o Flow Diversion to Waterloo WWTP. This option converts the St Jacobs WWTP to a pumping station and diverts all the flows to the Waterloo WWTP for treatment.
 - o Conventional Expansion
 - Non-infrastructure Opportunity
 - o Re-rating
- + Level of Treatment – A reduction in the effluent TP concentrations is expected to be required as part of a future expansion per MOECC Policy 2 requirements.
 - Infrastructure Options
 - o Phosphorus Removal (Expansion of Existing Tertiary Filters). This option includes using new tertiary filtration technologies that offer additional capacity in the same footprint as the existing sand filters.
 - Non-infrastructure Opportunity
 - o Phosphorus Off-setting. This option is based on continued operation of existing tertiary filters with funding for non-point source controls to off-set higher loadings at the St Jacobs WWTP.

A summary of the evaluation for the St Jacobs WWTP strategies of growth and level of treatment alternatives are presented in Table 36 and Table 37, respectively. Additional details are provided in TM10 - Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 36 Evaluation Summary of Strategies for Growth for the St Jacobs WWTP

Strategies for Growth			
Evaluation Category	Infrastructure Options		Non-Infrastructure Opportunity
	Diversion to Waterloo WWTP	Conventional Expansion	Capacity Re-rating
Environmental	<ul style="list-style-type: none"> • Potential environmental impact due to collection system construction 	<ul style="list-style-type: none"> • Minimal potential risk 	<ul style="list-style-type: none"> • Minor potential risk due to operation at higher loading rates
Social	<ul style="list-style-type: none"> • Potential for significant impacts due to collection system construction and lack of capacity within existing collection system 	<ul style="list-style-type: none"> • Largest land use, minimal land for future expansion • Potential for construction impacts 	<ul style="list-style-type: none"> • Minimal social impacts due to no construction • No collection system expansion required
Legal/ Jurisdictional	<ul style="list-style-type: none"> • Potential for easements for upgrades to collection system 	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Stress testing required prior to approval
Technical	<ul style="list-style-type: none"> • Makes use of capacity at Waterloo WWTP, to be considered only when upgrades are required at Waterloo WWTP 	<ul style="list-style-type: none"> • Does not make use of existing infrastructure 	<ul style="list-style-type: none"> • Optimizes existing infrastructure • Less robust due to higher loading rates
Financial	<ul style="list-style-type: none"> • Highest capital cost • Lowest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Moderate capital cost • Moderate operating cost • Moderate lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Highest operating cost • Lowest lifecycle cost

Table 37 Evaluation Summary of Level of Treatment Strategies for the St Jacobs WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Expansion of Existing Tertiary Filters)	Phosphorus Off-Setting
Environmental	<ul style="list-style-type: none"> • Minor potential impacts associated with expansion of filters • Expansion would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • No anticipated impacts as overall improvement to environment from non-point sources
Social	<ul style="list-style-type: none"> • Minor impacts due to expansion of existing process 	<ul style="list-style-type: none"> • Limited potential impacts due to construction of non-point source controls
Legal/ Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts as infrastructure would be within existing site footprint and most technologies are well understood 	<ul style="list-style-type: none"> • Significant effort required for approval • Extensive consultation required with MOECC and GRCA
Technical	<ul style="list-style-type: none"> • Minimal additional energy use or GHG emissions for expansion of existing tertiary process 	<ul style="list-style-type: none"> • Innovative method to achieve overall watershed improvements
Financial	<ul style="list-style-type: none"> • Highest capital cost • Lowest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Highest operating cost • Lowest lifecycle cost

Based on the evaluation, the following are the preferred infrastructure alternatives, with key considerations, together with any non-infrastructure opportunities recommended for further investigation:

Growth

- + Preferred Infrastructure Option: Expansion of St Jacobs WWTP Using Conventional Technologies.
 - Minimal environmental impacts due to well understood conventional treatment process

- Well understood process with no potential schedule or approval delays
- Moderate capital and operational costs

It is important to note that the option of diverting flows from St Jacobs to the Waterloo WWTP for treatment may be beneficial, but was not identified as the recommended option because it would be dependent on a variety of factors. First, Waterloo WWTP would need to have adequate capacity. An expansion at the Waterloo WWTP is to be initiated based on needs within its catchment area. However, if an expansion were already being completed, consideration for St Jacobs diversion could be made. Second, if re-rating is confirmed as a feasible option for the St Jacobs WWTP it would likely be preferable over diverting flows to the Waterloo WWTP (refer to Table 36 for details). As further studies and investigations are completed, the options should be reviewed to confirm the preferred approach based on the most recent information available.

- + Non-infrastructure Opportunity: Expansion by Re-rating (pending more detailed study to confirm feasibility).
 - Lowest cost alternative
 - Utilizes existing infrastructure
 - Accommodates small capacity increase required within the planning period
 - Minimal environmental and social impacts due to minimal construction required for implementation

It should also be noted that a key component of any approach for the St Jacobs WWTP is I/I reduction to reduce peak extraneous flows to the treatment plant.

In advance of an expansion, short-term improvements have been identified to address constraints for the existing conditions as identified in Section 4.6.5, including:

- + Temperature impact on plant performance. Very low temperatures ($<3^{\circ}\text{C}$) occasionally experienced in the oxidation ditch in the winter have had a negative impact on nitrification performance at the existing St Jacobs WWTP. Upgrades to the existing oxidation ditch aeration is required to reduce winter temperature drop and provide more efficient aeration control for nitrification. Upgrades to the aeration system should be completed immediately based on the operational challenges and asset renewal needs.

- + Flow constraints. While planning for plant expansion has been estimated for completion by 2025 for the St Jacobs WWTP, upgrades for the tertiary filtration and the UV disinfection system should be considered for implementation as early as 2019 to ensure the plant will continue to have adequate hydraulic capacity for the full range of flows. Upgrades to the tertiary filters and disinfection system are to be confirmed based on the outcome of the additional investigations for the St Jacobs and Waterloo WWTP. If diverting flows to the Waterloo WWTP is considered to be a preferred option, upgrades to the St Jacobs tertiary filters and disinfection system may not be necessary.

Level of Treatment

- + Preferred Infrastructure Option: Phosphorus Removal (Expansion of Existing Filters)
 - Low costs to expand existing tertiary filtration process
 - No environmental impacts due to well understood tertiary filtration process
 - No additional site space required since tertiary filtration expansion can occur within existing building footprint.
- + Non-Infrastructure Opportunity: Phosphorus Off-setting (pending more detailed study to confirm feasibility)
 - Lowest cost alternative
 - Utilizes existing tertiary treatment infrastructure already in place and incorporates a blended effluent strategy to maximize existing tertiary treatment capacity and utilize off-setting for additional load due to growth
 - Preserves site space for future growth
 - Minimal social impacts as construction is not required
 - Minimal environmental impacts since overall phosphorus loading to Grand River watershed is maintained.
 - As there is currently no program in place within the Region for phosphorus off-setting, a program would need to be developed, implemented and monitored.

6.3.5 Elmira WWTP

The alternatives to address the opportunities/constraints to accommodate for growth and level of treatment at the Elmira WWP are identified as follows:

- + Growth - Expansion to a minimum flow of 10,000 m³/d, which includes a 5% safety factor on the projected 2051 flow of 9,500 m³/d
 - Infrastructure Options
 - o Conventional Expansion
 - o Expansion Using New Technology (Granular Sludge or Similar)
- + Level of Treatment - A reduction in the effluent TP concentrations is expected to be required as part of a future expansion per MOECC Policy 2 requirements.
 - Infrastructure Option
 - o Phosphorus Removal (Expansion of Existing Tertiary Filters). This option includes using new tertiary filtration technologies that offer additional capacity in the same footprint as the existing sand filters.
 - Non-infrastructure Opportunity
 - o Phosphorus Off-setting. This option is based on continued operation of existing tertiary filters with funding for non-point source controls to off-set higher loadings at the Elmira WWTP.

A summary of the evaluation for the Elmira WWTP strategies of growth and level of treatment alternatives are presented in Table 38 and Table 39, respectively. Additional details are provided in TM10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 38 Evaluation Summary of Strategies for Growth for the Elmira WWTP

Strategies for Growth		
Evaluation Category	Infrastructure Options	
	Conventional Expansion	Expansion Using New Technology (Granular Sludge or Similar)
Environmental	<ul style="list-style-type: none"> • Minimal potential risk as technology is well understood and would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Minimal potential risk as expansion would be designed to meet treatment requirements
Social	<ul style="list-style-type: none"> • Largest land use, minimal land for future expansion • Potential for construction impacts 	<ul style="list-style-type: none"> • Some potential for construction impacts • Preserves space for future treatment requirements
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Pilot testing may be required for approval
Technical	<ul style="list-style-type: none"> • Does not make use of existing infrastructure 	<ul style="list-style-type: none"> • Energy savings • Limited full-scale experience • Utilizes existing infrastructure
Financial	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost

Table 39 Evaluation Summary of Level of Treatment Strategies for the Elmira WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Expansion of Existing Tertiary Filters)	Phosphorus Off-Setting
Environmental	<ul style="list-style-type: none"> • Minor potential impacts associated with expansion of filters. • Expansion would be designed to meet treatment requirements. 	<ul style="list-style-type: none"> • No anticipated impacts as overall improvement to environment from non-point sources
Social	<ul style="list-style-type: none"> • Minor impacts due to expansion of existing process 	<ul style="list-style-type: none"> • Limited impact due to construction of non-point source controls

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Expansion of Existing Tertiary Filters)	Phosphorus Off-Setting
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts as infrastructure would be within existing site footprint and technology is well understood. 	<ul style="list-style-type: none"> • Significant effort required for approval • Extensive consultation required with MOECC and GRCA
Technical	<ul style="list-style-type: none"> • Minimal additional energy use or GHG emissions for expansion of existing tertiary process 	<ul style="list-style-type: none"> • Innovative method to achieve overall watershed improvements • High loading requiring off-setting poses technical challenges
Financial	<ul style="list-style-type: none"> • Highest capital cost • Lowest operating cost • Lowest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Highest operating cost • Highest lifecycle cost

Based on the evaluation, the following are the preferred infrastructure alternatives, with key considerations:

Growth

- ✦ Preferred Infrastructure Option: Expansion Using New Technology (Granular Sludge or Similar)
 - Lowest cost alternative
 - New, innovative technology
 - Small footprint preserving space for future expansion, and allowing expanded capacity to be constructed within existing tankage, providing additional benefits on constrained site
 - Provides environmental benefits due to energy savings and greenhouse gas reductions

A key component of the approach for the Elmira WWTP is I/I reduction to reduce peak extraneous flows to the treatment plant.

In addition, short-term improvements are required to address constraints for the existing conditions as identified in Section 4.7.5, including:

- + High industrial loadings. High industrial loading contributions limits aeration capacity. Alternative process using granular sludge or similar could be used to address potential capacity short-falls of the bioreactors and oxygenation system. Continuing to work with local industries to reduce loading to the plant may also reduce future tankage requirements and preserve site capacity.
- + Insufficient sludge management and storage capacity. The blending tank is too small for the current operation and operation staff cannot get enough solids out. Therefore, additional sludge blending tanks would be required. The expanded sludge blending tanks should have sufficient capacity to allow blending of fermented primary sludge and WAS prior to dewatering.

Level of Treatment

- + Preferred Infrastructure Option: Phosphorus Removal (Expansion of Existing Tertiary Filters)
 - Lowest cost alternative
 - Utilizes existing tertiary treatment facility with retrofit to provide additional capacity for growth
 - High phosphorus load reduction challenging to achieve with phosphorus off-setting.

Non-infrastructure opportunities were not recommended for the Elmira WWTP.

6.3.6 Wellesley WWTP

The alternatives to address the opportunities/constraints to accommodate growth and level of treatment at the Wellesley WWTP are identified as follows:

- + Growth - Expansion to a minimum flow of 1,320 m³/d, which includes a 5% safety factor on the projected 2051 flow of 1,260 m³/d.
 - Infrastructure Options
 - o Conventional Expansion
 - o Expansion Using New Technology (Granular Sludge or Similar)

- ✦ **Level of Treatment.** A reduction in the effluent TP concentrations is expected to be required as part of a future expansion per MOECC Policy 2 requirements.
 - **Infrastructure Option**
 - Phosphorus Removal (Expansion of Existing Tertiary Filters)
 - **Non-infrastructure Opportunity**
 - Phosphorus Off-setting. This option is based on continued operation of existing tertiary filters with funding for non-point source controls to off-set higher loadings at the Wellesley WWTP.

A summary of the evaluation for the Wellesley WWTP strategies of growth and level of treatment alternatives are presented in Table 40 and Table 41, respectively. Additional details are provided in Tech Memo 10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

Table 40 Evaluation Summary of Strategies for Growth for the Wellesley WWTP

Strategies for Growth		
Evaluation Category	Infrastructure Options	
	Conventional Expansion	Alternative Technology (Granular Sludge or similar)
Environmental	<ul style="list-style-type: none"> • Minimal potential risk as technology is well understood and would be designed to meet treatment requirements 	<ul style="list-style-type: none"> • Minimal potential risk as expansion would be designed to meet treatment requirement
Social	<ul style="list-style-type: none"> • Largest land use, minimal land for future expansion • Potential for construction impacts 	<ul style="list-style-type: none"> • Some potential for construction impacts • Preserves space for future treatment requirements
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts 	<ul style="list-style-type: none"> • Pilot testing may be required for approval
Technical	<ul style="list-style-type: none"> • Does not make use of existing infrastructure 	<ul style="list-style-type: none"> • Energy savings • Limited full-scale experience
Financial	<ul style="list-style-type: none"> • Highest capital cost • Highest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Lowest operating cost • Lowest lifecycle cost

Table 41 Evaluation Summary of Level of Treatment Strategies for the Wellesley WWTP

Level of Treatment Strategies		
Evaluation Category	Infrastructure Option	Non-Infrastructure Opportunity
	Phosphorus Removal (Expansion of Existing Tertiary Filters)	Phosphorus Off-Setting
Environmental	<ul style="list-style-type: none"> • Minor potential impacts associated with expansion of filters • Expansion would be designed to meet treatment requirements. 	<ul style="list-style-type: none"> • No anticipated impacts as overall improvement to environment from non-point sources
Social	<ul style="list-style-type: none"> • Minor impacts due to expansion of existing process 	<ul style="list-style-type: none"> • Limited potential impacts due to construction of non-point source controls
Legal/Jurisdictional	<ul style="list-style-type: none"> • No anticipated impacts as infrastructure would be within existing site footprint and technology is well understood. 	<ul style="list-style-type: none"> • Significant effort required for approval • Extensive consultation required with MOECC and GRCA
Technical	<ul style="list-style-type: none"> • Minimal additional energy use or GHG emissions for expansion of existing tertiary process 	<ul style="list-style-type: none"> • Innovative method to achieve overall watershed improvements
Financial	<ul style="list-style-type: none"> • Highest capital cost • Lowest operating cost • Highest lifecycle cost 	<ul style="list-style-type: none"> • Lowest capital cost • Highest operating cost • Lowest lifecycle cost

Based on the evaluation, the following are the preferred infrastructure alternatives, with key considerations, together with any non-infrastructure opportunities recommended for further investigation:

Growth

- ✦ Preferred Infrastructure Option: Expansion Using New Technology (Granular Sludge or Similar)
 - Lowest cost alternative
 - New, innovative technology
 - Small footprint preserving space for future expansion

- Provides environmental benefits due to energy savings and greenhouse gas reductions

A key component of the approach for the Wellesley WWTP is inflow and infiltration reduction to reduce peak extraneous flows to the treatment plant.

Level of Treatment

- + Preferred Infrastructure Option: Phosphorus Removal (Expansion of Existing Tertiary Filters)
 - Low costs to expand existing tertiary filtration process
 - Minimal environmental impacts due to well understood tertiary filtration process
 - No additional site space required since tertiary filtration expansion can occur within existing building footprint.
- + Non-infrastructure Opportunity: Phosphorus Off-setting (pending more detailed study to confirm feasibility)
 - Lowest cost alternative
 - Utilizes existing tertiary treatment infrastructure already in place at the Wellesley WWTP
 - Preserves site space for future growth
 - Minimal social impacts due to no construction required
 - Minimal environmental impacts since overall phosphorus loading to Grand River is maintained.
 - As there is currently no program in place within the Region for phosphorus off-setting, a program would need to be developed, implemented and monitored for this alternative.

6.4 Sewage Pumping Station Alternatives

All Region pumping stations have adequate capacity to meet 2051 flow projections based on the current service areas with the exception of the Spring Valley, Morningside, and Baden SPSs. Table 42 summarizes the pumping station options evaluated.

Table 42 Short-Listed Pumping Station Options

Pumping Station	Description of Alternative
Bridgeport SPS	Do nothing (has capacity to meet 2051 flows)
Spring Valley SPS	Expansion to accommodate growth
Baden SPS	Continue hauling excess wastewater to accommodate growth
	Equalization tank expansion for peak flow
	Expansion to accommodate growth
Morningside SPS	Expansion to accommodate growth
Rose Street SPS	Do nothing (has capacity to meet 2051 flows)
Ayr SPS	Do nothing (has capacity to meet 2051 flows)
Nith River Way SPS	Do nothing (has capacity to meet 2051 flows)

Flows projected for the Spring Valley SPS catchment area up to 2051 (252 L/s) indicate a minor shortfall in existing firm capacity for the station (245 L/s). This shortfall is less than 3% (or 7 L/s) of the existing firm capacity of the pump station and can be addressed with future pump upgrades. Furthermore, significant upgrades are expected for the station based on the current condition of the assets. The asset renewal timelines are expected to be within the next 10 years, which is well before 2046 when the station capacity is reached. This is an opportune time to provide an increase in the firm capacity to a minimum of 265 L/s (includes a 5% safety factor over the 2051 projected flow). Pump testing at the station is recommended closer to the pump replacement timeline to refine overall system curves (and C-Factor for forcemains) for the proper pump selection to meet the targeted firm capacity. In addition, potential changes to the forcemain alignment as related to the upcoming Ministry of Transportation of Ontario work should be considered.

For the Morningside SPS, a recent assessment (Stantec, 2017) concluded that pump replacement can provide a firm capacity of 290 L/s, which exceeds the projected 2051 flow of 272 L/s. In consideration of asset renewal timelines and code deficiencies (existing pumps are not the rated electrical classification to meet the most up-to-date codes), replacement of the existing pumps should be considered in the next 10 years. This is an opportune time to increase the firm capacity with minimal additional cost to the Region, and well in advance of 2041 when capacity is reached. Although flow projections have considered overall growth for Baden and New Hamburg, the capacity needs at the Morningside SPS are impacted by the pump capacity at Baden

SPS, as Baden SPS pumps into the Morningside SPS catchment. A final recommended capacity for Morningside SPS would be dependent on the recommendations for Baden SPS.

For the Baden SPS, there is a projected shortfall in capacity for 2051 flows. There are opportunities to reduce peak flows to the Baden SPS through I/I reduction. Even with successful reductions in I/I, increases to the equalization storage, pumping capacity, or both equalization storage and pumping capacity may be required to accommodate future flows. As noted, options for the Baden SPS and Morningside SPS are interrelated as the Baden SPS pumps directly to the Morningside SPS. Furthermore, the Morningside SPS then pumps directly to the New Hamburg WWTP.

Based on the interrelation of these facilities, a more detailed study should be undertaken for the Baden and Morningside SPSs to determine the best overall approach for the pumping stations to address capacity and operational constraints.

6.5 Enhance Operations and Reduce Energy Usage

Improving the operation and performance of individual unit processes could be implemented with goals to address an existing bottleneck, reduce energy needs or improve performance. One of the key objectives of the Region's 2018 WWTMP update is to consider energy reduction and efficiency, as well as innovation within wastewater treatment. In order to enhance operations and reduce energy use, options should be considered as a component of any upgrade, and can also be considered without expansion based on a business case to provide a rationale for implementation as a stand-alone project.

The 2018 WWTMP Update has investigated opportunities for the reduction of energy and GHG emissions through innovative processes and technologies. As part of this objective, other related initiatives were considered, including recovery of energy and nutrients, minimizing waste, and water reuse to provide more environmentally sustainable and innovative wastewater treatment.

Options short-listed for evaluation included:

- ✦ Chemically Enhanced Primary Treatment (CEPT) - reduce the biochemical oxygen demand (BOD) and total suspended solids (TSS) loading to secondary treatment by improving BOD and TSS removal in primary treatment. Based on

existing infrastructure, this option was reviewed for the Kitchener and Waterloo WWTPs

- ✦ Sidestream Treatment – implementation of sidestream treatment of dewatering centrate to reduce nutrient loading to the liquid treatment train. This option was reviewed for the Kitchener, Galt, and Waterloo WWTPs as they have onsite digestion and dewatering facilities.
- ✦ Anoxic Selector – Installation of anoxic selector to provide a pre-denitrification stage in a nitrifying plant, which can partially offset the energy costs associated with nitrification and reduce the total nitrogen concentration in the effluent. This option was reviewed for plants that currently do not have an anoxic selector (Galt, Hespeler, St Jacobs, and Wellesley)
- ✦ Automation Upgrades – Installation of on-line automation to provide real-time control for nutrient removal. Two potential automation upgrades include ammonia analyzers and phosphate analyzers. This option could be considered for all Regional WWTPs.
- ✦ Co-Digestion – Import high energy waste (i.e., fats, oils, greases) for co-digestion to increase biogas production. This option was considered at the Kitchener and Waterloo WWTPs, as they have available digester capacity.
- ✦ Thermal Hydrolysis – Addition of a thermal hydrolysis pre-treatment (THP) process to produce more biogas for beneficial uses. This option was considered for the largest treatment facilities (Kitchener, Galt, and Waterloo WWTP) due to operational complexity.

It was recognized that while these opportunities would provide long-term value to the Region, they may not be required to meet growth or level of treatment requirements. Therefore, opportunities for enhancing operation and reducing energy uses were reviewed on a business case basis by completing a life-cycle cost assessment. Details regarding the life-cycle cost assessments for compatible facilities are provided in TM10 – Development and Evaluation of Short-Listed Options, available in Appendix L.

Based on the life-cycle cost assessments, the following recommendations were made to enhance operations and reduce energy usage:

- + CEPT – conduct a trial at the Waterloo WWTP, which already has all necessary equipment installed, to assess the benefits.
- + Sidestream treatment – consider for the Kitchener WWTP (largest plant with greatest payback), if alternative funding is available.
- + Anoxic selector – recommended for installation at WWTPs that do not currently have anoxic selectors during asset renewal diffuser replacements.
- + Automation upgrades – implement on-line phosphorus and ammonia analyzers at the three largest plants (Kitchener, Waterloo, Galt WWTP) which offer the greatest payback opportunity.
- + Co-Digestion – a study is recommended to determine potential waste sources and costs to refine the overall cost-benefit analysis.
- + Thermal hydrolysis – recommended for consideration at the Kitchener WWTP if alternative funding is available.

In addition to the above, optimizing the operation of the existing wastewater treatment infrastructure is an important consideration to enhance operation and reduce energy use for any WWTP. The Region has partnered with the GRCA and the MOECC to improve the operation of wastewater treatment plants through participation in the Wastewater Optimization Program (referred to as Optimization). The Optimization process is in progress for several of the wastewater treatment plants in Waterloo Region. In addition, the Region is participating in a Performance Based Training pilot program organized by the MOECC.

6.6 Summary

A summary of the plant specific growth and level of treatment recommendations is shown in Table 43. To ensure that the Region has a fully-funded plan in place following the completion of this WWTMP Update, for each plant, for both growth and level of treatment, an infrastructure option has been selected as the preferred alternative, and non-infrastructure opportunities are noted where available for future investigation.

Table 43 Summary of Growth and Level of Treatment Recommendations

WWTP	Growth Recommendations		Level of Treatment Recommendations	
	Infrastructure Option	Non-Infrastructure Opportunity	Infrastructure Option	Non-Infrastructure Opportunity
Kitchener	• None required		• None required	
Waterloo	• Expansion with new technology (granular sludge or similar)	• Expansion by re-rating	• Phosphorus removal (new tertiary filters) at Waterloo WWTP	None
Galt	• None required		• Can achieve Lake Erie Basin limits with existing tertiary filters. No upgrades required, however, ECA will need to be updated to reflect new treatment requirements	
Preston	• None required		• Phosphorus removal (optimization of secondary treatment) at Preston WWTP	None
Hespeler	• Expansion using new technology (MABR or similar)	None	• Phosphorus removal (optimization of secondary treatment) at Hespeler WWTP	None
Ayr	• None required		• None required	
New Hamburg	• None required		• None required	
Wellesley	• Expansion using new technology (granular sludge or similar)	None	• Phosphorus removal (expansion of existing filters) at Wellesley WWTP	• Phosphorus off-setting

WWTP	Growth Recommendations		Level of Treatment Recommendations	
	Infrastructure Option	Non-Infrastructure Opportunity	Infrastructure Option	Non-Infrastructure Opportunity
St Jacobs	• Expansion using conventional technology	• Expansion by re-rating	• Phosphorus removal (expansion of existing filters) at St Jacobs WWTP	• Phosphorus off-setting
Elmira	• Expansion using new technology (granular sludge or similar)	None	• Phosphorus removal (expansion of existing filters) at Elmira WWTP	None
Foxboro	• None required		• None required	
Conestoga	• None required		• None required	
Heidelberg	• None required		• None required	

A summary of the business case options and recommendations to enhance operations and reduce energy usage at the WWTPs is shown in Table 44.

Table 44 Summary of Business Case Recommendations

Item	Benefit	General Findings	Summary of Recommendation
Chemically Enhanced Primary Treatment	<ul style="list-style-type: none"> • Increase digester gas production • Reduce aeration energy demands 	<ul style="list-style-type: none"> • Chemical costs and increase sludge production off-set energy savings 	<ul style="list-style-type: none"> • Consider for trial at Waterloo WWTP to document the cost-benefits. No capital investment required.
Sidestream Treatment (Deammonification and Post-Aerobic Digestion Considered)	<ul style="list-style-type: none"> • Reduce overall energy cost • Reduce biosolids production 	<ul style="list-style-type: none"> • Post-aerobic Digestion (PAD) offers greatest savings opportunity to Region 	<ul style="list-style-type: none"> • Consider PAD for sidestream treatment at Kitchener with highest overall payback, if alternative funding available.

Item	Benefit	General Findings	Summary of Recommendation
Anoxic Selector	<ul style="list-style-type: none"> • Reduce aeration energy cost 	<ul style="list-style-type: none"> • Relatively low capital investment for on-going energy savings 	<ul style="list-style-type: none"> • Integrate with any planned diffuser replacement project (i.e., asset management) or with planned expansion
Automation Upgrades	<ul style="list-style-type: none"> • Reduce chemical and energy usage 	<ul style="list-style-type: none"> • Instrumentation is cost limited payback to larger facilities 	<ul style="list-style-type: none"> • Implement full-scale trial at larger plant (Waterloo or Kitchener) for detailed cost-benefit assessment • Assess results of ortho-phosphate analyzer at Kitchener WWTP for savings potential
Co-Digestion	<ul style="list-style-type: none"> • Use high energy waste from industry to produce digester gas 	<ul style="list-style-type: none"> • Competing market for high energy wastes • Potential for good payback at Kitchener and Waterloo WWTP 	<ul style="list-style-type: none"> • Complete market study and conceptual design to finalize business case for Kitchener and Waterloo WWTP
Thermal Hydrolysis Process (THP)	<ul style="list-style-type: none"> • Reduce biosolids production • Increase gas production • Improve dewaterability 	<ul style="list-style-type: none"> • Requires operation of steam system • Significant labour cost in Ontario for plants currently only staffed during daytime 	<ul style="list-style-type: none"> • Can be considered for Kitchener WWTP if alternative funding available.

7. Public and Stakeholder Consultation

7.1 Communications and Consultation Plan

A Communication and Consultation Plan was developed to provide meaningful information and engagement opportunities to the public and stakeholders. A summary of the communication and consultation activities is provided in the following sections.

7.2 Communication Activities

7.2.1 Project Contacts

The following is a summary of key stakeholders and agencies on the project contact list:

- + Members of the public who expressed an interest in the 2018 WWTMP Update;
- + Regional Councillors;
- + Academics from local universities;
- + Special interest groups and community associations including environmental groups, neighbourhood associations, business/commerce organizations, and recreational clubs;
- + Review agencies such as provincial ministries and agencies, federal departments and agencies, local area municipalities, school boards, transit, utilities (natural, gas, cable, telephone, etc.);
- + Conservation authorities and environmental stakeholders, including the GRCA;
- + First Nations and Aboriginal Groups; and
- + Neighbouring municipalities

Details regarding the contact list are provided in Appendix N.

7.2.2 Project Notices

Project notices were issued for the 2018 WWTMP Update for the following:

- + Notice of Study Commencement;
- + Notice of Public Consultation Centre No. 1;

- + Notice of Public Consultation Centre No. 2; and
- + Notice of Study Completion.

Notices were published in local newspapers (Woolwich Observer, Kitchener Post, New Hamburg Independent, Cambridge Times, Waterloo Chronicle, Ayr News), posted on the Region's website and mailed to those included on the Project Contact List.

7.3 Consultation Activities

Two committees were formed as part of the 2018 WWTMP Update to guide the development of the plan: the Planning & Technical Advisory Committee (PTAC) and the Steering Committee. The general public had opportunity to engage and comment on the Master Plan at two rounds of Public Consultation Centres. These consultation activities are summarized in the following sections.

7.3.1 Planning & Technical Advisory Committee (PTAC)

The PTAC was a non-political advisory committee established by the Region to assist the Project Team by providing advice and feedback at key milestones over the course of the Master Plan. Members of PTAC included representatives from organizations that are direct stakeholders in the planning and decision making process for this project. Accordingly, the Region identified and invited representatives from local area municipalities, GRCA, MOECC, Greater KW Chamber of Commerce, academics, and representatives of Regional departments.

The key objectives of the PTAC was to:

- + Help focus the Project Team's attention on components of the WWTMP where the most effort is warranted.
- + Identify opportunities for the Project Team to improve the work plan.
- + Share ideas and approaches that the Project Team may not have otherwise considered.
- + Help the Project Team to accurately gauge the relative importance of issues and evaluation criteria.
- + Provide constructive feedback on the Project Team's technical and public consultation approach.

- + Maximize the technical quality of the WWTMP update, by sharing relevant expertise with the committee and Project Team.
- + Increase the Project Team's understanding of the expectations, interests and concerns of each organizations (agencies, municipal communities etc.).
- + Share information and facilitate engagement of the organizations represented by committee members, and facilitate opportunities for the Project Team to address the concerns of those organizations as early as possible in the project.
- + Provide information specific to the agency or municipality represented which could impact or be useful to the Project Team (for example, current or anticipated policy, regulations, strategic initiatives, development plans, data, reports, etc.).
- + Help the Project Team to make the WWTMP as effective and efficient as possible.

The following meetings were held with the PTAC:

- + Meeting No. 1 (September 22, 2015): Review of WWTMP background information, consultation and communications plan and WWTMP Update work plan.
- + Meeting No. 2 (May 31, 2016): Review project plan, existing WWTP status and capacities, and evaluation methodology and criteria.
- + Meeting No. 3 (August 2, 2017): Review liquid and solids treatment options including Regional wastewater options, plant-specific options, and short-listed options.
- + Meeting No. 4 (November 9, 2017): Review development and evaluation of short-listed options, including energy reduction and operational enhancements.

7.3.2 Steering Committee

The purpose of the Steering Committee is to provide advice and direction to Project Team at key milestones over the course of the Master Plan, including the following:

- + Opportunity statement;
- + Evaluation approach, including evaluation criteria, weighting factors and proposed methodology;

- + Evaluation results and final recommendations;
- + Identification of anticipated impacts and mitigation measures;
- + Communication and consultation activities and approach; and
- + Related project issues and items as may be identified as the project evolved.

The Steering Committee included the project consultant, assigned Regional Councillors, and representatives of the Region's Transportation and Environmental Services Department, Planning, Development, and Legislative Services Department, and Financial Services and Development Financing Department. A total of five (5) meetings were held with the Steering Committee:

- + Meeting No. 1 (September 22, 2015): Provided an introduction to the project and reviewed the purpose and composition of the Steering Committee.
- + Meeting No. 2 (March 16, 2016): Presented information on the existing conditions of the Region treatment facilities.
- + Meeting No. 3 (July 26, 2016): Presented future growth scenarios that were developed to identify future servicing needs. Provided an overview of the evaluation criteria and methodology to be used to evaluate options for each plant.
- + Meeting No. 4 (August 29, 2017): Reviewed the long-list of wastewater treatment alternatives and presented the short-listed alternatives to be further developed for detailed evaluation.
- + Meeting No. 5 (November 17, 2017): Presented the results of the evaluation process for short-listed alternatives, including the preliminary preferred wastewater treatment alternatives.

7.3.3 Public Consultation Centres

Two rounds of three Public Consultation Centres (PCCs) were held during the 2018 WWTMP Update. For each round of PCCs, locations were selected in Cambridge, Waterloo and Kitchener. An overview of the PCCs is provided below:

- + PCC No. 1 (March 7, 8 and 9, 2017): Provided background information on wastewater treatment in the Region; introduced the WWTMP Update and why it

is being completed; and provided an opportunity for input on the approach for developing solutions and how they will be evaluated.

- ✦ PCC No. 2 (December 5, 7 and 14, 2017): Reviewed preferred wastewater treatment alternatives for growth and level of treatment.

The PCCs used a drop-in format to communicate study information to the general public and seek advice into the Master Planning process. Approximately 21 people attended the round of PCCs in March 2017 and 36 attended the round of PCCs in December 2017. People were generally in support of the recommended alternatives presented.

8. Preferred Alternatives and Implementation Plan

Projects required to implement the preferred solutions (as outlined in Section 6) were identified to develop an implementation plan. The implementation plan includes Regional wastewater recommendations, plant-specific recommendations to accommodate growth and meet level of treatment needs, and opportunities to enhance operations and reduce energy use.

To ensure the Region has a fully funded and feasible plan for plant-specific needs, infrastructure options have been recommended to accommodate growth and meet level of treatment needs; however, non-infrastructure opportunities have also been identified for further investigation. Infrastructure recommendations are approaches that are more widely accepted by the industry and there is a high level of confidence that approvals could be obtained (such as expansions to existing processes or installing new technologies). Non-infrastructure options represent new approaches and will require additional studies and consultation to confirm feasibility and approvals. It can be noted that some new minor infrastructure may be required for non-infrastructure opportunities; however, these opportunities are more focused on changes to operations or implementing new programs to achieve objectives.

The implementation plan outlines the approach for both infrastructure recommendations and non-infrastructure opportunities. Non-infrastructure opportunities will be further investigated to confirm feasibility. If found to be feasible, non-infrastructure opportunities may be implemented, otherwise, the implementation plan will move forward with the infrastructure recommendation.

The implementation plan provides capital costs for recommended projects, which include construction costs for the individual unit processes where applicable, an estimating allowance (35% of total construction costs), general contractor's overhead (15% of total construction costs) and engineering fee (15% of total construction costs). Cost estimates for studies have also been identified in the implementation plan based on previous project experience.

Depending on the time between implementing a project and the completion of the WWTMP Update, the state of the industry should be reviewed as part of an expansion or upgrade. This review is recommended to determine if new or innovative technologies have been developed that may provide a benefit to the Region, and

account for potential changes to regulatory requirements or anticipated level of treatment needs.

8.1 Regional Wastewater Recommendations

8.1.1 Inflow/Infiltration Reduction

A number of initiatives have been undertaken, some through the partnership of the local municipalities and the Region, to identify and remedy I/I issues in Waterloo Region. Initiatives have included flow monitoring, CCTV inspections, rehabilitation and repair work.

Elevated I/I has been identified within the following WWTP service areas:

- + St Jacobs
- + Elmira
- + Wellesley
- + Ayr

It is recommended that the Region continue to encourage I/I identification and reduction opportunities, including:

- + Sewer flow monitoring programs to assist with I/I issue identification.
- + Sewer collection system modeling studies to quantify I/I distributions across service areas and evaluate cost-effective remediation strategies.
- + I/I remediation actions based on the findings of the studies
- + Promotion and education on impacts of private side connections (i.e. foundation drains and downspout connections) on the collection system.

For service areas with high extraneous flows, I/I reduction should be an integral part of any approach for the associated facilities; however, it will not serve as a stand-alone solution.

8.1.2 Watershed Management

The Grand River watershed management is a collaborative effort among the watershed municipalities, provincial and federal governments, and First Nations. The

purpose is to ensure a healthy river system and linkage to Lake Erie, secure water supplies, manage flood risks and deal with climate change (GRCA, 2014).

The following actions are recommended as part of the Region's commitment to the integrated Grand River watershed management:

- + Continue to collaborate with key stakeholders, such as the GRCA, on the GRCA Watershed Water Management Plan;
- + Continue with the SWQMP for supporting upgrades and expansions of WWTPs, and to better understand the long-term impact of these facilities and non-point sources on the receiving rivers and streams.
- + Apply watershed management concepts to evaluate the opportunities of optimizing sewer collection and flow distribution in the Region's WWTPs. This includes the partial flow diversion from the plants that may have capacity constraints to those which have available capacity.
- + Investigate a phosphorus off-setting program to reduce phosphorus loading to the Grand River watershed and allow for a limited increase in phosphorus discharge to be "off-set" by greater reductions elsewhere in the same watershed.

8.1.3 Water Re-use

Re-use of treated wastewater should be considered to reduce potable water consumption where practical and deemed to provide value. Future consideration of water re-use within Waterloo Region would require a more detailed study to determine the applicability and feasibility of water reuse options. Key factors to consider through this assessment include:

- + Identification of the potential users and types of re-use demands
- + Effluent quality and volume available for re-use
- + Location of the potential end user(s) relative to the wastewater treatment facility
- + Level of treatment required and technical feasibility
- + Costs associated with treatment and distribution of re-use water
- + Regulatory requirements
- + Public acceptance of re-used water

- ✦ Health concerns associated with the microbiological and/or chemical constituents in treated wastewater
- ✦ Environmental concerns of the constituents in treated wastewater associated with water reclamation and re-use.

Funding may be available through the Federation of Canadian Municipalities (FCM) for plans and studies related to water re-use.

One potential opportunity for investigating water re-use within the Region includes the ESLs. This area of growth has been identified primarily for employment development, and water re-use may be particularly beneficial for new potential industries. There are also fewer challenges for implementing a water re-use scheme within newly developed areas as compared to retrofitting existing infrastructure.

8.1.4 Resource Recovery

Wastewater has a number of constituents that can be considered as a resource for recovery. Key items for consideration are nutrients (nitrogen and phosphorus) for fertilizer production and biopolymers, recovery of valuable trace metals or using digester gas to produce methanol or ammonia. There are also opportunities for converting biosolids to a resource (i.e., fuel source, additive for brick manufacturing, etc.), which are considered as part of the parallel Biosolids Master Plan.

Research on new technologies for resource recovery is on-going and should be reviewed at the time of any upgrades and as part of future Master Plan updates for future applicability to Region facilities. As an example of developing technologies, high-rate algae production is being developed to recover phosphorus with the benefits of lower loadings to the receiving waterbody, reduced chemical costs and opportunities for biopolymer production.

8.1.5 Industrial Pre-treatment

The Region is in the process of reviewing and updating the Sewer-Use By-Law. This includes an evaluation of the existing discharge limits and prohibitions, current industrial discharges, and impacts on the Region's WWTPs. The Region is also reviewing the surcharge rate calculation method and plans to incorporate recommended changes in the Sewer-Use By-Law.

Surcharge Agreements are valid for one year. Limits are adjusted based on impact, available treatment capacity and actual discharge characteristics prior to renewal.

Based on the experience from other Ontario and North American municipalities, a combination of preventing the discharge of any inhibitory substances and allowing a capped over-strength surcharge appears to be the most widely adopted approach to implementing industrial pre-treatment programs. The collected service fees and surcharge fees can be used for improvement of wastewater treatment systems and optimization of the industrial pre-treatment program.

8.1.6 Asset Management

As part of Region's asset management and renewal, the Region should consider the energy use of each of the treatment processes. Energy neutrality is not currently within the Master Plan's mandate, however, energy reduction strategies provide a foundation for potentially becoming energy neutral in the future.

Some key asset management optimization opportunities include:

- + **Pumps:** Selection of pumps with high efficiencies and/or reduced maintenance costs
- + **Blowers:** Any replacement should consider blowers with higher operating efficiencies, improved turndown capacity and reduced maintenance costs.
- + **Aeration diffusers:** Select diffusers and layout density to maximize operating efficiency and reduce life cycle costs. During diffuser replacement, there is also an opportunity to consider incorporation of an anoxic selector, at the facilities where this is not already present, to reduce energy consumption.
- + **Disinfection equipment:** During asset replacement, consider alternative UV equipment with improved efficiency and turn-down capacity and/or alternative disinfection technologies (i.e., peracetic acid or similar).

These optimization improvements should be considered as part of every asset replacement to reduce overall energy costs.

Specific to individual WWTPs, the following asset management and renewal opportunities should be considered in conjunction with other upgrades or projects undertaken at the facility:

- + Galt WWTP: There are several asset management and renewal items that have been noted based on the recently completed Facility Plan (CIMA, 2016). The Region is currently undertaking upgrades at the Galt WWTP to address these items.
- + Preston WWTP:
 - Replacement of UV medium pressure reactors should consider new technology (such as peracetic acid) or more efficient UV system
 - Short-term opportunity to improve controls of the UV system based on water quality.
- + Hespeler WWTP:
 - Diffuser replacement in the next 10 years
 - Replacement of chlorination/dechlorination with alternative technology (peracetic acid or UV).
- + New Hamburg WWTP: Several asset management and renewal opportunities have been identified. The Region is currently undertaking an expansion and upgrade at the New Hamburg WWTP to address these items.
- + Wellesley WWTP:
 - Ozone replacement should consider newer technology such as peracetic acid
 - Headworks screening and flow diversion improvements (under construction)
 - Raw sewage pumping station refurbishment
 - WAS and sludge storage refurbishment
- + St Jacobs WWTP:
 - Oxidation ditch brush aerator motor gear drives. Opportunity to consider a more energy efficient aeration technology to replace aging brush aerators (under design)
 - Secondary clarifier enclosure needs repairs

- Sludge handling equipment needs replacement.
- + Elmira WWTP:
 - Primary and secondary clarifier mechanisms need replacement or repair

8.2 Growth and Level of Treatment Improvements

8.2.1 Waterloo WWTP

The Waterloo WWTP has a current ECA rated average day flow capacity of 57,500 m³/d. Based on flow projections in the WWTMP, the trigger for initiating an expansion (85% of the rated capacity) would be reached by approximately 2020 and the ECA rated capacity would be reached by approximately 2041. It is noted that an expansion may be required earlier if flows or loadings increase at a rate higher than projected. Based on a sensitivity analysis, the plant expansion is targeted for completion by end of 2028 to minimize the potential for capacity constraints (refer to TM11 - Sensitivity Analysis, available in Appendix M, for details).

The sections below provide a summary of the recommended infrastructure option, and non-infrastructure opportunities that require further investigation to confirm feasibility (refer to Section 8 for additional details).

8.2.1.1 Recommended Infrastructure Option

The preferred approach to accommodate future growth and effluent quality at the Waterloo WWTP includes:

- + Growth (expansion to a minimum flow of 63,600 m³/d)
 - Expansion Using New Technology (i.e. Granular Sludge or Similar)
- + Level of Treatment
 - Phosphorus Removal (New Tertiary Filters)

The following sections discuss the projects resulting from the above recommendations.

Class EA and Conceptual Design (2021 - 2023)

A Schedule C Class EA will be required to provide additional treatment capacity. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Review of 2014 ACS results with the recent river water quality monitoring data to confirm if the ACS recommended effluent objectives are still valid for use in plant expansion scenarios.
- + Develop and evaluate alternative design concepts (including investigation of available new technologies).
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the Waterloo WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Pilot testing, if required. As a new technology, MOECC may require pilot testing of a granular sludge system to demonstrate performance for approval.
- + Prepare Environmental Study Report (ESR).
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$1,500,000

Expansion Using New Technology (Granular Sludge or Similar) with Tertiary Treatment (2023 – 2028)

Key components of the expansion using new technology to provide a minimum flow of 63,600 m³/d are anticipated to include:

- + Detailed design (2023-2025)
- + Construction (2025-2028)
 - Add one additional raw influent and effluent pump
 - Convert the existing aeration tanks to granular sludge system, if confirmed through Class EA to be the preferred technology
 - Install new tertiary filters

Estimated cost for expansion: \$60,000,000

A conceptual site layout of the Waterloo WWTP in 2051 is shown in Figure 15.

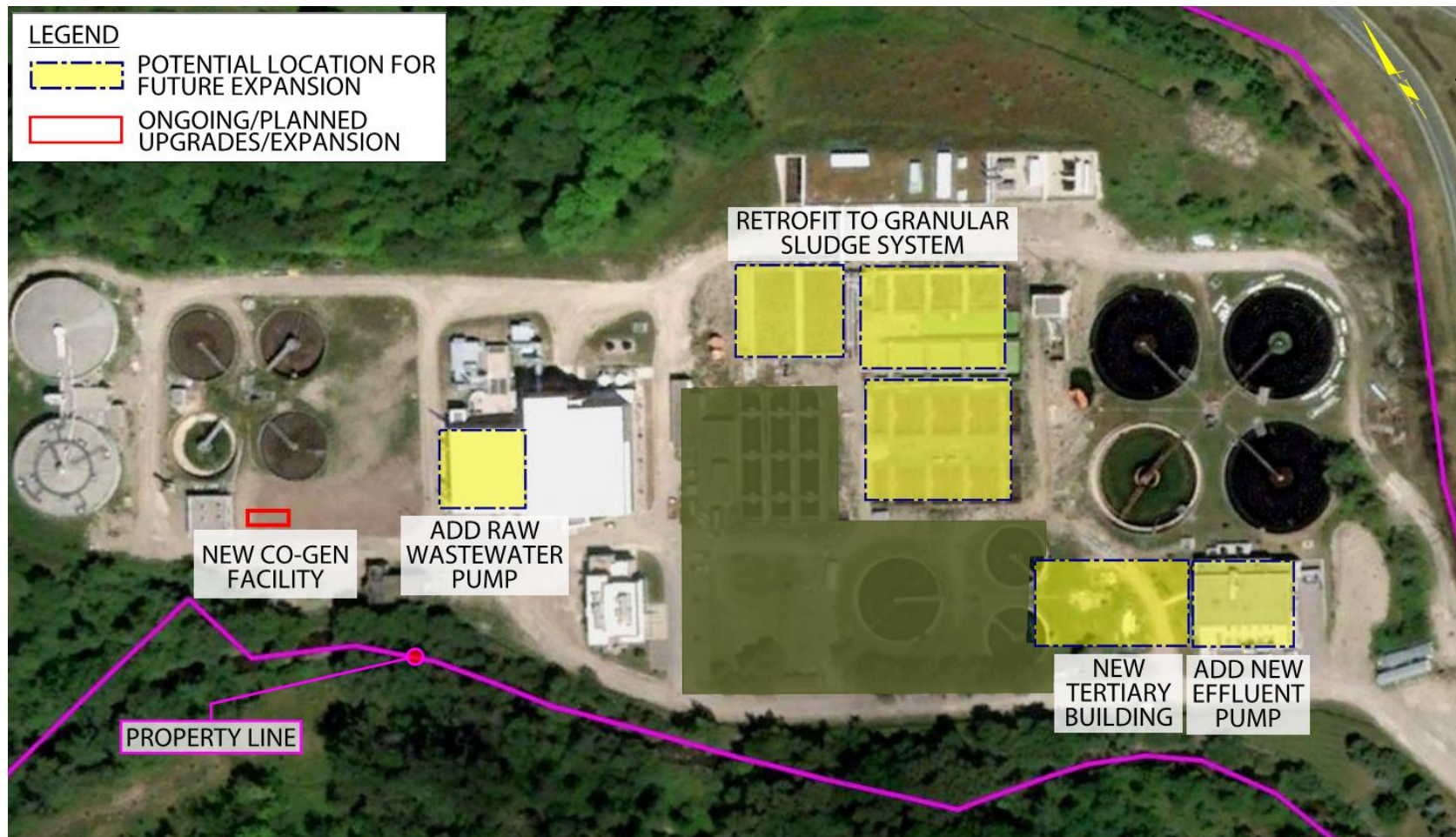


Figure 15 Conceptual Layout of Waterloo WWTP in 2051

8.2.1.2 Non-infrastructure Opportunity

For the Waterloo WWTP, the capacity review indicated that most unit processes have sufficient capacity to accommodate the future projected 2051 flows without expansion, with the exception of the raw influent and effluent pumping, and secondary clarification processes (i.e. limited by surface overflow rates). These capacity-limiting processes were designed based on the MOECC Design Guidelines, which may be conservative. An opportunity has been identified to investigate the potential to re-rate the existing plant in lieu of a traditional physical expansion.

Prior to completing the Class EA for a physical expansion (as outlined in the recommended infrastructure option), further investigations are recommended to determine the feasibility of re-rating. The following provides an overview of the implementation plan should re-rating be feasible. It should be noted that if re-rating is found not to be feasible at any stage, the infrastructure option will be implemented.

Waterloo and St Jacobs Optimization Study (2018-2020)

To confirm the feasibility of the re-rating opportunity, an optimization study is recommended. The Waterloo and St Jacobs WWTPs both have similar opportunities noted for re-rating, therefore, it is recommended that one optimization study is completed for both plants. A combined study is also beneficial as the recommendations of the Waterloo WWTP may influence the preferred approach for the St Jacobs WWTP due to the proximities of the facilities. An overview of how the approach for the two WWTPs may influence one another is summarized as follows:

- ✦ Should re-rating be feasible for both the Waterloo and St Jacobs WWTPs, the two plants would be expanded with the following non-infrastructure opportunities:
 - Waterloo WWTP
 - Expansion by re-rating with tertiary treatment
 - St Jacobs WWTP
 - Expansion by re-rating with phosphorus off-setting; or
 - Expansion by re-rating with expansion to tertiary treatment (no phosphorus off-setting)

- + Should re-rating be feasible for the Waterloo WWTP but not feasible for the St Jacobs WWTP, the St Jacobs WWTP would be physically expanded and the Waterloo WWTP would be expanded through re-rating with the non-infrastructure opportunity noted above.
- + Should re-rating be feasible for the St Jacobs WWTP but not feasible for the Waterloo WWTP, the Waterloo WWTP would be physically expanded and the St Jacobs WWTP would be reviewed to confirm the preferred option.
- + Should re-rating not be feasible for either of the Waterloo or St Jacobs WWTPs, the Waterloo WWTP would be physically expanded and the St Jacobs WWTP would be reviewed to confirm the preferred option.

As further studies and investigations are completed, the above options should be reviewed to confirm the preferred approach based on the most recent information available.

The Waterloo and St Jacobs optimization study is recommended to review the following:

- + Refine requirements for optimization and re-rating
 - Update the design basis
 - Conduct detailed unit process capacity assessments
 - Identify opportunities for unit process re-rating
 - Develop options to address plant bottlenecks
- + Update process model (e.g. BioWin) for re-rating scenarios
- + Review of available river water quality information to confirm suggested effluent objectives/limits at the re-rated Waterloo WWTP flows
- + Perform plant hydraulic analysis to evaluate process hydraulic bottlenecks and outfall capacity
- + Field testing to demonstrate/confirm capacities
- + Liaison with MOECC to discuss the rationale, approach and findings from the optimization and re-rating studies.

Estimated cost for the optimization study: \$900,000

Depending on the outcome of the optimization study, should re-rating be feasible for the Waterloo WWTP, the following non-infrastructure opportunity is proposed:

- + Expansion by re-rating with tertiary treatment

The following sections discuss the projects resulting from the above recommendation.

Class EA and Conceptual Design for Re-Rating with Tertiary Treatment (2021 – 2022)

If re-rating of the Waterloo WWTP is considered feasible based on the outcome of the Optimization Study, a Schedule C Class EA will still be required to provide additional treatment capacity.

The Class EA study would include the same key tasks as outlined in Section 8.2.1.1, however, the alternative design concepts developed will be specific to re-rating and tertiary filters. The investigation of available new technologies would still be included in this Class EA, specifically with respect to tertiary filters.

Estimated cost for Class EA and Conceptual Design: \$800,000

Expansion by Re-Rating with Tertiary Treatment (2023 – 2028)

Key components of the expansion through re-rating are anticipated to include:

- + Detailed design (2023-2025)
- + Construction (2025-2028)
 - Add one additional raw influent and effluent pump
 - Install new tertiary filters

Estimated cost for expansion: \$31,000,000

It should be noted that the amount of a capacity increase by re-rating will need to be confirmed through the Optimization Study. A physical expansion will still be needed for the Waterloo WWTP in the long term; however, re-rating the plant would defer a more costly physical expansion. The amount of capacity increase that can be achieved through re-rating would determine how long the physical expansion could be deferred.

8.2.2 Preston WWTP

The Preston WWTP has a current ECA rated average day flow capacity of 16,800 m³/d. Based on flow projections in the WWTMP, the existing plant has sufficient capacity to accommodate the projected 2051 flow. As a result, no expansion beyond the rated capacity would be required during the planning period. However, phosphorus removal is expected to be required to meet Lake Erie effluent phosphorus target during the planning period.

8.2.2.1 Recommended Infrastructure Option

The preferred approach to accommodate future effluent quality at the Preston WWTP includes:

- + Level of Treatment
 - Phosphorus Removal (Optimization of Secondary Treatment)

The following sections discuss the projects resulting from the above recommendation.

Process Optimization Study (2019-2020)

To confirm the feasibility of improving phosphorus removal through optimization of the secondary treatment process (e.g. optimization of existing chemical dosing system), an optimization study is recommended to review the following:

- + Sampling and wastewater characterization
- + Jar testing to identify chemicals and dosage
- + Full scale pilot to determine optimum dosing points and dosage

Estimated cost for the optimization study: \$200,000

Process Optimization (2021)

Key components of the process optimization of secondary treatment are anticipated to include:

- + Modifications to dosing lines and dosing points
- + Potential upgrades to the dosing pumps and controls

Estimated cost for process optimization: \$200,000.

8.2.3 Hespeler WWTP

The Hespeler WWTP has a current ECA rated average day flow capacity of 9,320 m³/d. Based on flow projections in the WWTMP, the trigger for initiating an expansion (85% of the rated capacity) flow would be reached by approximately 2036 and the ECA rated capacity would be reached by approximately 2047. Based on a sensitivity analysis, the plant expansion is targeted for completion by end of 2043 to minimize the potential for capacity constraints (refer to TM11 – Sensitivity Analysis, available in Appendix M, for details).

8.2.3.1 Recommended Infrastructure Option

The preferred approach to accommodate future growth and effluent quality at the Hespeler WWTP includes:

- + Growth (expansion to a minimum flow of 10,400 m³/d)
 - Expansion using New Technology (MABR or Similar)
- + Level of Treatment
 - Phosphorus Removal (Optimization of Secondary Treatment)

The Hespeler WWTP is currently in the process of the design and construction for short-term upgrades. In addition, the Hespeler WWTP is only facility in the Region that currently (or after on-going upgrades) does not provide year-round nitrification for the plant rated capacity. The 2014 ACS recommended nitrification to a TAN effluent objective of 2 mg/L (non-freezing) and 5 mg/L (freezing) for the Hespeler WWTP. An upgrade to the plant is recommended to provide reliable year-round nitrification ahead of a plant expansion.

The following sections discuss the projects resulting from the above recommendations.

Short-term Upgrades (2018-2020)

Key components of the short-term upgrades include:

- + Detailed design (2018)
- + Construction (2018-2020)
 - Headworks upgrades

- Phosphorus removal improvements
- New WAS thickening facility

Estimated cost for short-term upgrades: \$15,650,000

Nitrification Upgrades (2020-2022)

An upgrade project is recommended to provide reliable year-round nitrification ahead of a plant expansion, including:

- + Conceptual design (2020)
- + Detailed design (2020-2021)
- + Construction (2021-2022)
 - Installation of MABR or similar process

Estimated cost for nitrification upgrades: \$7,100,000

Class EA Study and Conceptual Design for Expansion (2036-2038)

A Schedule C Class EA will be required to provide additional treatment capacity. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Update of 2014 ACS to confirm recommended effluent objectives for the plant expansion.
- + Develop and evaluate alternative design concepts (including investigation of available new technologies).
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the Hespeler WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Prepare ESR.
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$700,000

Expansion using New Technology (MABR or Similar) (2039-2043)

Key components of the expansion using new technology to provide a minimum flow of 10,400 m³/d are anticipated to include:

- + Detailed design (2039-2041)
- + Construction (2041-2043)
 - Construction of additional MABR tanks, if confirmed through the Class EA to be the preferred technology
 - Upgrades to disinfection system

Estimated cost for expansion: \$15,500,000

A conceptual site layout of the Hespeler WWTP in 2051 is shown in Figure 16.

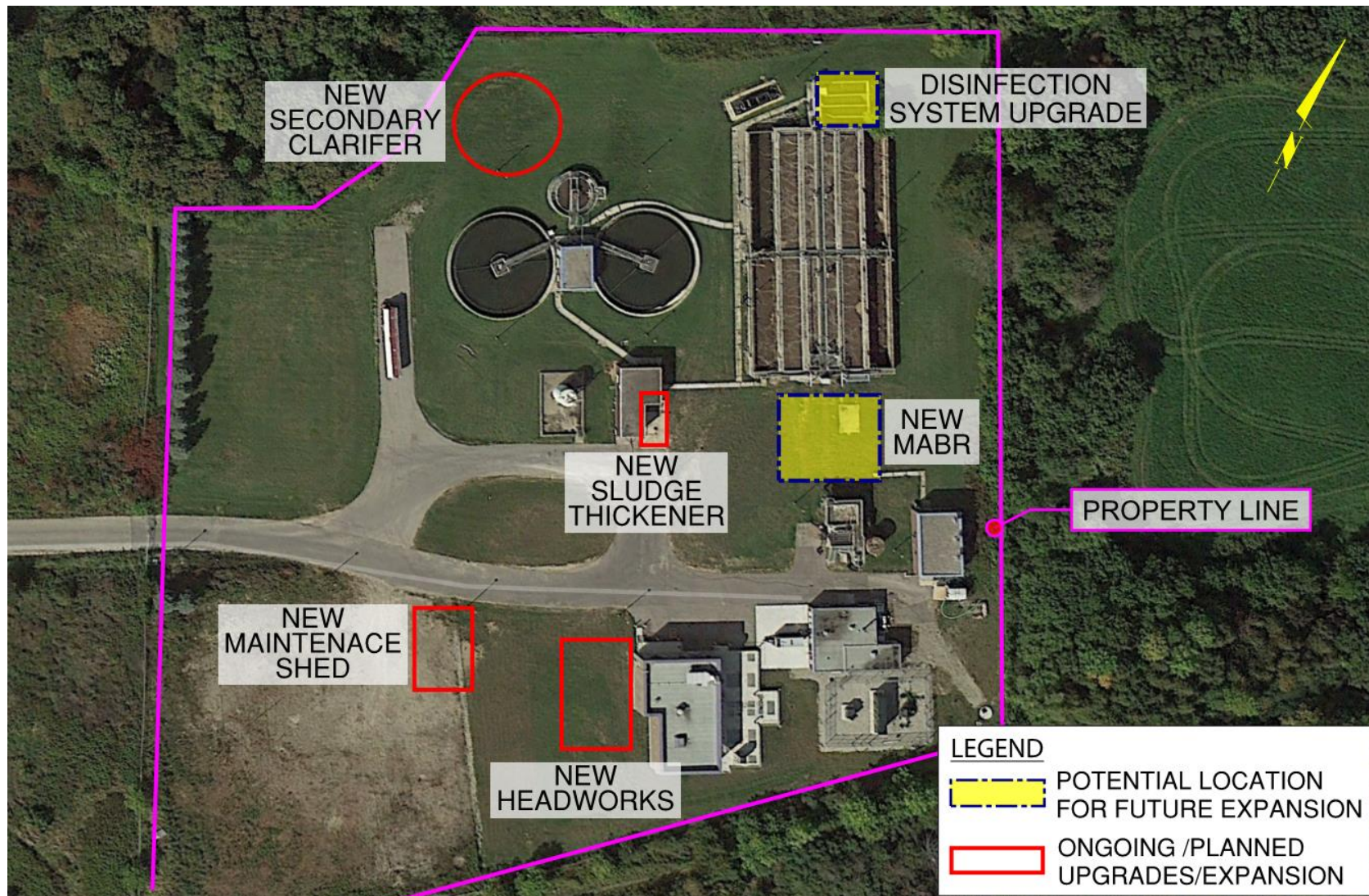


Figure 16 Conceptual Layout of Hespeler WWTP in 2051

8.2.4 St Jacobs WWTP

The St Jacobs WWTP has a current ECA rated average day flow of 1,450 m³/d. Based on flow projections in the WWTMP, the trigger for initiating an expansion (85% of the rated capacity) would be reached by approximately 2025 and the ECA rated capacity would be reached by approximately 2042. Based on a sensitivity analysis, the plant expansion is targeted for completion by end of 2029 to minimize the potential for capacity constraints (refer to TM11 – Sensitivity Analysis, available in Appendix M, for details).

The sections below provide a summary of the recommended infrastructure option, and non-infrastructure opportunities that require further investigation to confirm feasibility (refer to Section 8 for additional details).

8.2.4.1 Recommended Infrastructure Option

The preferred approach to accommodate future growth and effluent quality at the St Jacobs WWTP includes:

- + Growth (expansion to a minimum flow of 1,600 m³/d)
 - Expansion using Conventional Technology; or
 - Flow Diversion to Waterloo WWTP (only feasible if the Waterloo WWTP is physically expanded)
- + Level of Treatment
 - Phosphorus Removal (Expansion of Existing Tertiary Filters)

It should be noted that, depending on the outcome of the Waterloo and St Jacobs WWTP Optimization Study, the preferred approach to accommodate future growth and effluent quality at the St Jacobs WWTP may vary. For example, the option of flow diversion from the St Jacobs to the Waterloo WWTP is only viable if the Waterloo WWTP is physically expanded (refer to Section 8.2.1.2).

In addition, as discussed in Section 4.6.3, very low temperatures (<3°C) experienced in the oxidation ditch in the winter have had a negative impact on nitrification performance at the existing St Jacobs WWTP. Short-term improvements have been identified for the oxidation ditch aeration to reduce winter temperature drop and provide more efficient aeration control. Short-term work is also required to address

flow constraints related to peak flows. While planning for plant expansion has been identified for completion by 2025, upgrades for tertiary filtration and the UV disinfection system should be considered for implementation as early as 2019 to ensure the plant will continue to have adequate hydraulic capacity for the full range of flows. The need for these upgrades will be confirmed by the Waterloo and St Jacobs Optimization Study (refer to Section 8.2.1.2)

The following sections discuss the projects resulting from the above recommendations.

Short-term Improvements (2019-2021)

Short-term improvements are recommended to address potential capacity constraints and opportunities. Key components of the project are anticipated to include the following:

- + Conceptual design (2019)
- + Detailed design (2020)
- + Construction (2021)
 - Oxidation ditch aeration system upgrades - to be completed immediately based on operational challenges and asset renewal needs
 - Tertiary filtration and disinfection upgrades – to be completed if confirmed by the Optimization Study (refer to Section 8.2.1.2).

Estimated cost for short-term improvements: \$3,100,000

Class EA and Conceptual Design for Expansion if Waterloo WWTP Not Physically Expanded (2023-2025)

A Schedule C Class EA will be required to provide additional treatment capacity through a conventional expansion. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Develop and evaluate alternative design concepts (including investigation of available new technologies).
- + Public, Agency, Indigenous and other stakeholder consultation.

- + Although the St Jacobs WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Prepare ESR.
- + Conceptual Design of the recommended upgrades

In addition, an ACS will be required to confirm effluent objectives for the expanded plant, as a recent ACS specific to the St Jacobs WWTP is not available.

Estimated cost for Class EA and Conceptual Design: \$300,000

Expansion using Conventional Technology (2026-2029)

Key components of the expansion using conventional technology to provide a minimum flow of 1,600 m³/d are anticipated to include:

- + Detailed design (2026-2027)
- + Construction (2028-2029)
 - Expansion to a minimum flow of 1,600 m³/d by replacing oxidation ditch with extended aeration tanks, if confirmed through the Class EA to be the preferred technology
 - Demolish the existing oxidation ditch

Estimated cost for expansion: \$12,000,000

A conceptual site layout of the St Jacobs WWTP in 2051 is shown in Figure 17.

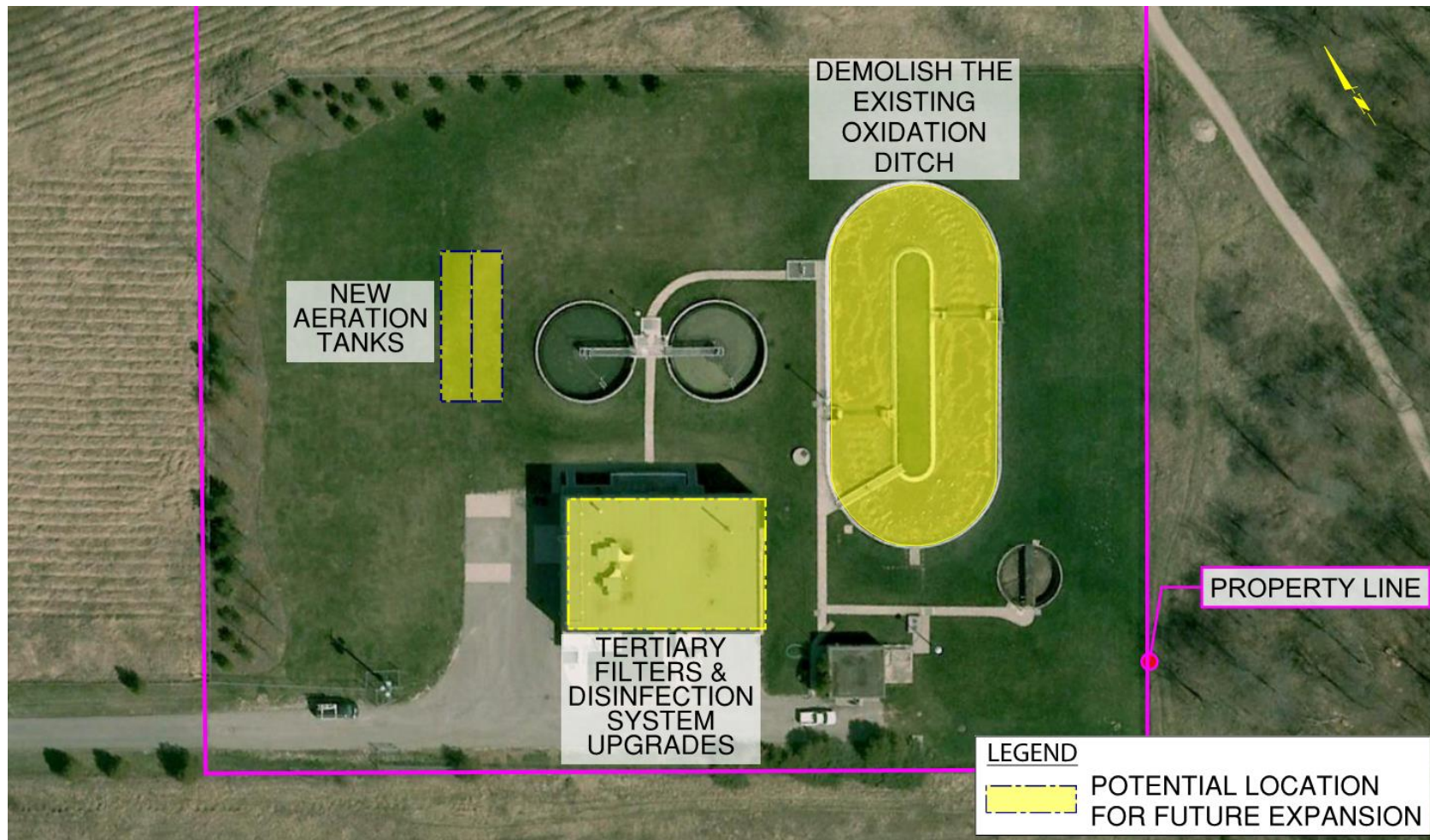


Figure 17 Conceptual Layout of St Jacobs WWTP in 2051

Class EA and Conceptual Design if Waterloo WWTP is Physically Expanded (2022-2023)

As mentioned in Section 8.2.1.2, flow diversion to the Waterloo WWTP may be beneficial depending on the outcome of the Optimization Study (i.e. the Waterloo WWTP is physically expanded and re-rating the Jacobs WWTP isn't feasible/beneficial). A Schedule C Class EA will be required to determine whether a conventional expansion or diversion of wastewater flows from the St Jacobs WWTP to the Waterloo WWTP would be preferred. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Develop and evaluate alternative design concepts.
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the St Jacobs WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Prepare ESR
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$400,000

Flow Diversion to Waterloo WWTP (if Waterloo WWTP is Physically Expanded and Diversion is Preferred through Class EA) (2024-2029)

Key components of the flow diversion to Waterloo WWTP are anticipated to include the following:

- + Detailed design (2024-2026)
- + Construction (2027-2029)
 - Construct a new pump station and forcemain to transfer flows from the St Jacobs WWTP to the Waterloo WWTP.
 - Increased expansion of the Waterloo WWTP to provide a minimum capacity of 65,200 m³/d rather than 63,600 m³/d. This slight increase in capacity can be provided by the expansion using new technology already considered for the Waterloo WWTP.

- Potential upgrades to the Waterloo WWTP collection system to accommodate increased flow from the St Jacobs service area.

Estimated cost for flow diversion to Waterloo WWTP: \$8,000,000

It should be noted that cost for the expansion of the Waterloo WWTP is not included in the above cost, as flow diversion to the Waterloo WWTP is only feasible if the Waterloo WWTP is physically expanded and already has available capacity to receive flows from St Jacobs.

8.2.4.2 Non-infrastructure Opportunity

For the St Jacobs WWTP, the capacity review indicated that some unit processes require additional capacity to treat the future projected 2051 flows, including influent pumping, bioreactor, tertiary filtration, and UV disinfection. These processes were designed based on the MOECC Design Guidelines, which are considered conservative. Therefore, opportunities exist to increase the plant capacity by optimizing the plant instead of completing a traditional physical expansion.

Prior to completing the Class EA for a physical expansion (as outlined in the recommended infrastructure option), further investigations are to be completed to determine the feasibility of re-rating. The following provides an overview of the implementation plan should re-rating be feasible. It should be noted that if re-rating is not feasible, the infrastructure option will be implemented.

Waterloo and St Jacobs Optimization Study (2018-2020)

The St Jacobs and Waterloo WWTPs both have similar opportunities noted for re-rating, therefore, it is recommended that one study is combined for both plants. More details about the combined optimization study are provided in Section 8.2.1.2. In addition to the optimization of the existing facility, a study to identify phosphorus off-setting opportunities, costs and program requirements is recommended for the St Jacobs WWTP.

Should re-rating be feasible for the St Jacobs WWTP (to be determined through the Optimization Study), the following opportunities were proposed:

- + Expansion by re-rating with phosphorus off-setting; or
- + Expansion by re-rating with expansion of tertiary treatment (no phosphorus off-setting)

The following sections discuss the projects resulting from the above recommendations.

Class EA and Conceptual Design for Re-rating with Phosphorus Off-setting (2021 – 2022)

If re-rating and phosphorus off-setting for the St Jacobs WWTP are considered feasible based on the outcome of the optimization and phosphorus off-setting study, a Schedule B Class EA will be required.

The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Develop and evaluate alternative design concepts specific to re-rating and phosphorus off-setting
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the St Jacobs WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Prepare Project File report
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$300,000

Expansion by Re-rating with Phosphorus Off-setting (2022-2024)

Key components of the expansion through re-rating with phosphorus offsetting are anticipated to include:

- + Detailed design (2022-2023)
- + Construction (2023-2024)
 - Infrastructure for phosphorus off-setting program (e.g., manure storage facilities, milkhouse wastewater treatment and livestock fencing around local creeks)
 - Disinfection systems upgrades. This includes upgrades beyond the short-term improvements identified for the plant, such that a moderate capacity

increase may be accommodated (to be confirmed through the Optimization Study).

Estimated cost for expansion: \$1,760,000

Class EA and Conceptual Design for Re-rating with Expansion of Tertiary Treatment (No Phosphorus Off-setting) (2021 – 2022)

If re-rating of the St Jacobs WWTP is considered feasible but phosphorus off-setting is not feasible based on the outcome of the optimization and phosphorus off-setting studies, the St Jacobs WWTP will be expanded by re-rating with expansion of tertiary treatment. A Schedule C Class EA will be required for the re-rating and additional tertiary treatment capacity.

The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Develop and evaluate alternative design concepts specific to re-rating and tertiary filtration
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the St Jacobs WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Prepare Project File report
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$200,000

Expansion by Re-rating with Expansion of Tertiary Treatment (No Phosphorus Off-setting) (2023-2026)

Key components of the expansion through re-rating with expansion of tertiary treatment are anticipated to include:

- + Detailed design (2023-2024)
- + Construction (2024-2026)

- Tertiary filtration system upgrades. This includes upgrades beyond the short-term improvements identified for the plant, such that a moderate capacity increase may be accommodated (to be confirmed through the optimization study).
- Disinfection systems upgrades. This includes upgrades beyond the short-term improvements identified for the plant, such that a moderate capacity increase may be accommodated (to be confirmed through the Optimization Study).

Estimated cost for expansion: \$3,000,000

8.2.5 Elmira WWTP

The Elmira WWTP has a current ECA rated average day flow of 7,800 m³/d. Based on flow projections in the WWTMP, the trigger for initiating an expansion (85% of the rated capacity) would be reached by 2030 and the ECA rated capacity would be reached by 2039. Based on a sensitivity analysis, the plant expansion is targeted for completion by end of 2030 to minimize the potential for capacity constraints (refer to TM11 – Sensitivity Analysis, available in Appendix M, for details).

8.2.5.1 Recommended Infrastructure Option

The preferred approach to accommodate future growth and effluent quality at the Elmira WWTP includes:

- + Growth (expansion to a minimum flow of 10,000 m³/d)
 - Expansion using New Technology (Granular Sludge or Similar)
- + Level of Treatment
 - Phosphorus Removal (Expansion of Existing Tertiary Filters)

For the Elmira WWTP, the capacity review indicated that several treatment processes do not have sufficient capacity for the current design flow, including the primary clarifiers, bioreactors, oxygenation system and UV disinfection system.

The primary clarifiers and UV disinfection system have sufficient capacity for the current flow but not for the plant design flow. This is due to the significant I/I issue experienced at the plant, which results in higher sustained wet weather flows and

higher peak factors (i.e. a historic peak day factor of 3.2 based on the plant data) than original design values (i.e. a peak day factor of 2.5).

The bioreactor aerobic zone SRT and oxygen availability are the primary limiting factors of the plant. This is due to the historic elevated influent BOD₅ concentrations from industrial sources (i.e. a historic BOD₅ of 260 mg/L based on plant data) as compared to the original plant design concentration (i.e. a BOD₅ of 190 mg/L). If the influent BOD₅ loadings were similar to the original design basis, additional capacity within the bioreactors and oxygenation system would be available. Short-term improvements have been identified to address bioreactor capacity constraints based on loadings to the plant that exceed the design values.

It is recommended to undertake an optimization study to confirm the impact of recent work with local industries to reduce the loading to the plant and determine the true capacity of unit processes. The outcome of the optimization study will be used to confirm the design basis and timing for both the short-term improvements and the proposed expansion.

The following sections discuss the projects resulting from the above recommendations.

Optimization Study (2020)

An optimization study is recommended for the Elmira WWTP to determine the true field capacity of individual unit processes, which will assist in confirming the design basis and timing for both short-term improvements and the proposed expansion. The optimization study will include the following key tasks:

- + Refine requirements for optimization
 - Update the design basis (e.g., flow quantity and its variation (average, maximum and peak), and influent and effluent characteristics)
 - Conduct detailed unit process capacity assessments
 - Identify opportunities for unit process optimization
 - Develop options to address plant bottlenecks
- + Update process model (e.g. BioWin) to determine the capacity and performance of existing treatment facilities

- + Perform plant hydraulic analysis to evaluate process hydraulic bottlenecks
- + Field testing to demonstrate/confirm capacities
- + Review to confirm granular sludge or similar technology is preferred approach to address process constraints related to secondary treatment
- + Pilot testing of granular sludge, or similar technology, if required by MOECC

Estimated cost for optimization study: \$300,000.

Short-term Improvements (2021-2022)

Short-term improvements are recommended to address potential capacity short-falls of the bioreactors and oxygenation system identified as part of the capacity review. Key components of the project are anticipated to include the following:

- + Detailed design (2020-2021)
- + Construction (2021-2022)
 - Retrofit existing aeration tanks to granular sludge technology or similar
 - Modifications to RAS/WAS piping systems
 - Oxygenation capacity upgrades
 - On-site sludge management and storage improvements

Estimated cost for short-term improvements: \$3,000,000

Class EA Study and Conceptual Design (2024-2025)

A Schedule C Class EA will be required to provide additional treatment capacity. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity.
- + Develop and evaluate alternative design concepts (including investigation of available new technologies).
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the Elmira WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.

- + Prepare ESR.
- + Conceptual Design of the recommended upgrades

In addition, an ACS will be required to confirm effluent objectives for the expanded plant, as a recent ACS specific to the Elmira WWTP is not available.

Estimated cost for Class EA and Conceptual Design: \$400,000

Expansion using New Technology (Granular Sludge or Similar) (2026-2030)

Key components of the expansion using new technology to a minimum flow of 10,000 m³/d are expected to include:

- + Detailed design (2026-2028)
- + Construction (2028-2030)
 - Demolish the two existing circular clarifiers and the “old” unused aeration tanks built in 1967, leaving the footprint available for new rectangular primary clarifiers.
 - Construct two new primary clarifiers
 - Add additional aeration capacity
 - Tertiary filtration and UV disinfection system upgrades
 - On-site sludge management improvements

Estimated cost for expansion: \$17,000,000

The proposed conceptual site layout for the Elmira WWTP is shown in Figure 18.

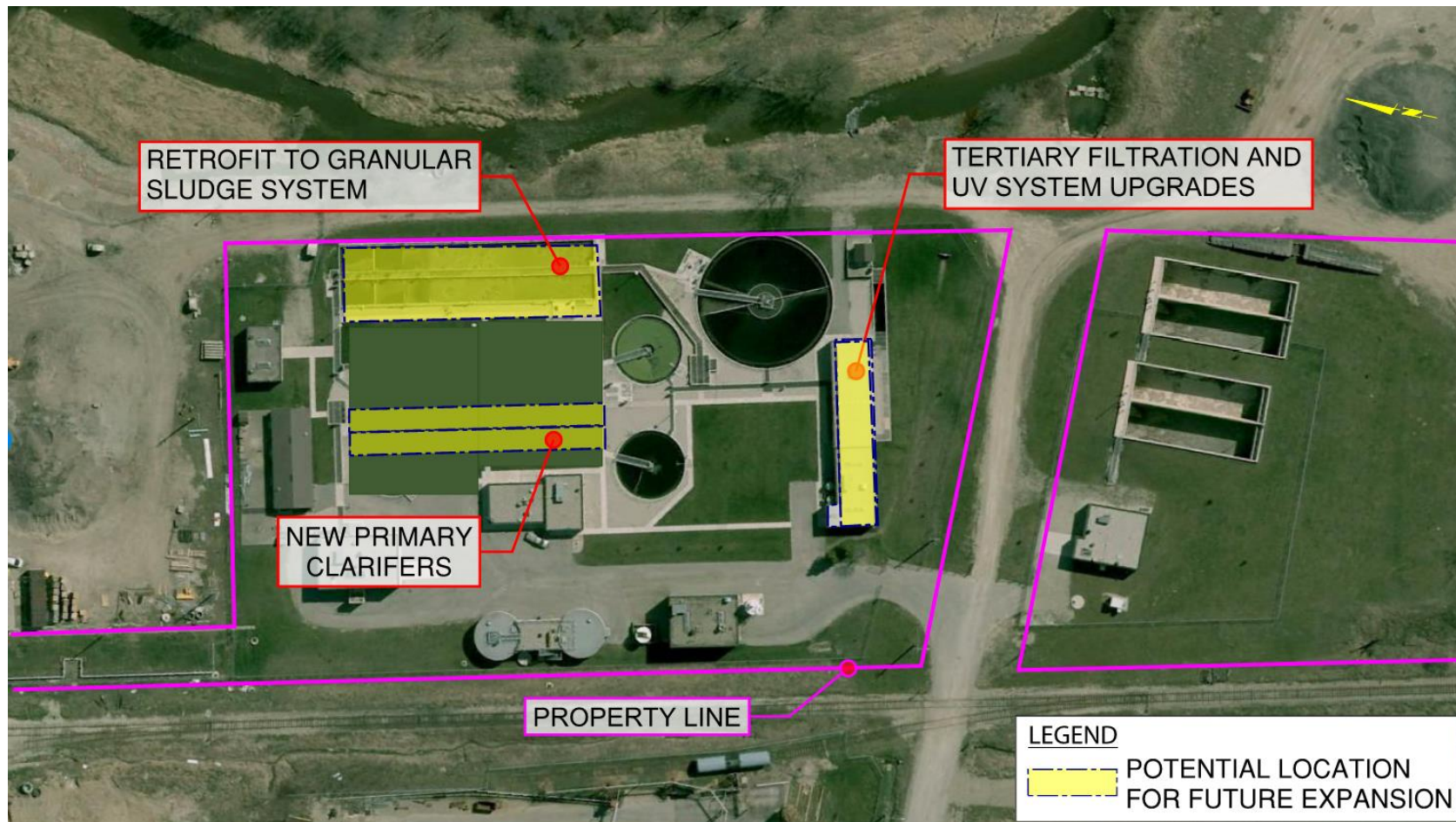


Figure 18 Conceptual Layout of Elmira WWTP in 2051

8.2.6 Wellesley WWTP

The Wellesley WWTP has a current ECA rated average day flow of 1,100 m³/d. Based on flow projections in the WWTMP, the trigger for initiating an expansion (85% of the rated capacity) would be reached by 2032 and the ECA rated capacity would be reached by 2041. Based on a sensitivity analysis, the plant expansion is targeted for completion by end of 2035 to minimize the potential for capacity constraints (refer to TM11 – Sensitivity Analysis, available in Appendix M, for details).

The sections below provide a summary of the recommended infrastructure option, and non-infrastructure opportunities that require further investigation to confirm feasibility (refer to Section 8 for additional details).

8.2.6.1 Recommended Infrastructure Option

The preferred approach to accommodate future growth and effluent quality at the Wellesley WWTP includes:

- + Growth (to a minimum flow of 1,320 m³/d)
 - Expansion using New Technology (Granular Sludge or Similar)
- + Level of Treatment
 - Phosphorus Removal (Expansion of Existing Tertiary Filters)

The following sections discuss the projects resulting from the above recommendations.

Class EA Study and Conceptual Design (2030-2031)

A Schedule C Class EA will be required to provide additional treatment capacity. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity
- + Develop and evaluate alternative design concepts (including investigation of available new technologies)
- + Public, Agency, Indigenous and other stakeholder consultation

- + Although the Wellesley WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Pilot testing for preferred technology, if required by MOECC
- + Prepare ESR
- + Conceptual Design of the recommended upgrades

In addition, an ACS will be required to confirm effluent objectives for the expanded plant, as a recent ACS specific to the Wellesley WWTP is not available.

Estimated cost for Class EA and Conceptual Design: \$300,000

Expansion using New Technology (Granular Sludge or Similar) (2032-2035)

Key components of the Wellesley WWTP expansion using new technology to a minimum flow of 1,320 m³/d include:

- + Detailed design (2032-2033)
- + Construction (2034-2035)
 - Add additional raw influent pump capacity
 - Convert the existing aeration tanks to granular sludge system, if confirmed through the Class EA to be the preferred technology
 - Tertiary filtration system upgrades

Estimated cost for expansion: \$8,000,000

A conceptual site layout of the Wellesley WWTP in 2051 is shown in Figure 19.

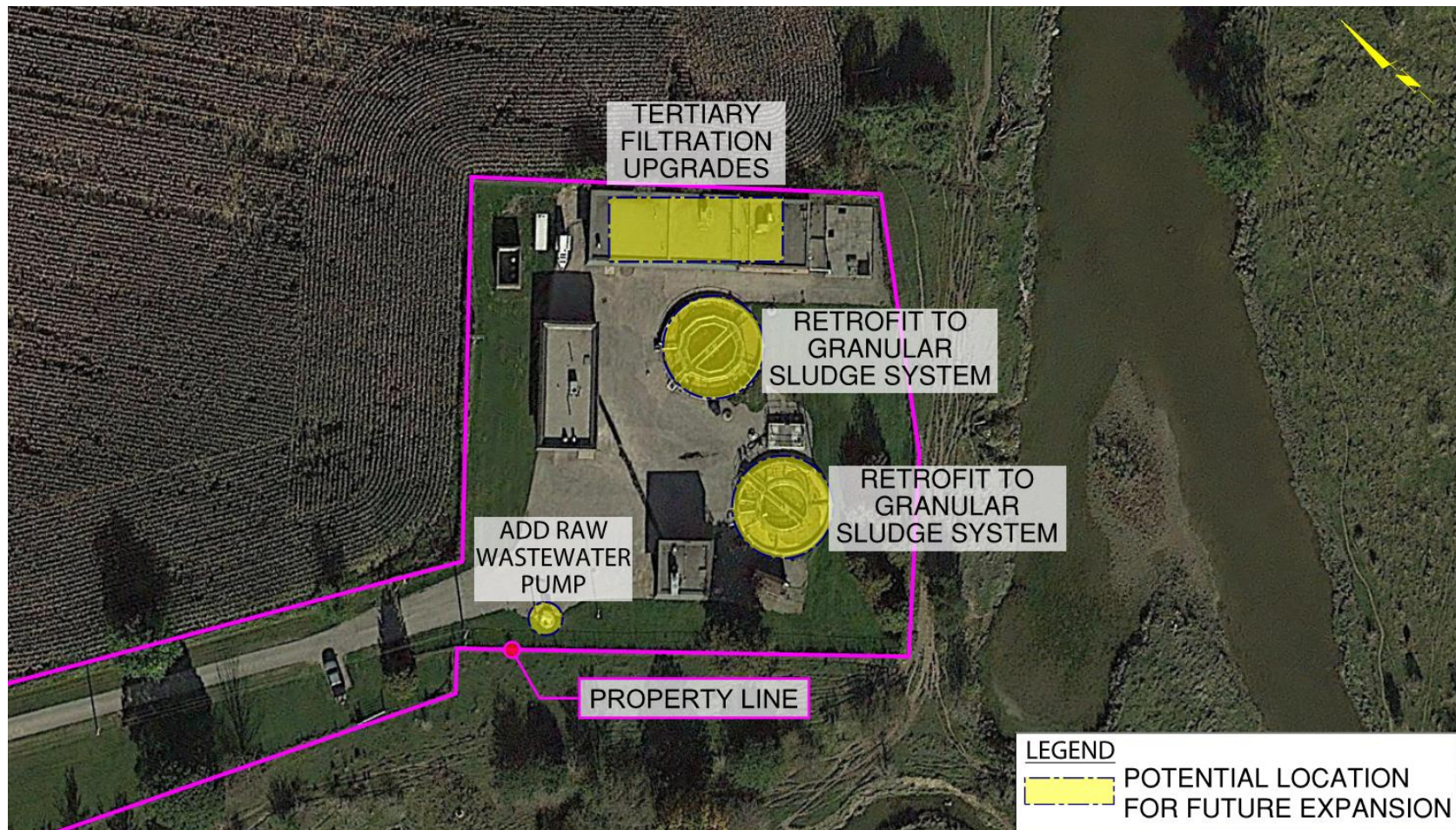


Figure 19 Conceptual Layout of Wellesley WWTP in 2051

8.2.6.2 Non-infrastructure Opportunity

For the Wellesley WWTP, the capacity review indicated that all the unit treatment processes have sufficient capacity for the current flows and the plant design flow, with the exception of secondary clarification capacity which is slightly less than the plant design flow. This is due to the high I/I experienced at the plant, which results in high wet weather flows and higher peak factors (i.e. a PHF of 4.0) than typical design values. An optimization study is recommended to confirm the impact of planned I/I reduction measures (2018-2019) and determine the true capacity of unit processes including the recently upgraded tertiary filters. In addition to the optimization of the existing facility, a study to identify phosphorus off-setting opportunities, costs and program requirements is recommended.

The study to further investigate the feasibility of plant optimization and phosphorus optimization is recommended prior to completing the Class EA for a physical expansion (as outlined in the infrastructure option). This will allow the outcome of the study to be used to confirm the design basis and timing for the proposed expansion. The following provides an overview of the implementation plan should plant optimization and/or phosphorus off-setting be feasible. It should be noted that if phosphorus off-setting is not feasible, the recommended infrastructure option (e.g. tertiary filtration system upgrades) will be implemented. The results of the optimization study will not change the recommended option to accommodate growth (i.e. expansion with new technology); however, it may impact the recommended timing.

Optimization and Phosphorus Off-Setting Study (2028-2029)

An optimization study is recommended for the Wellesley WWTP to determine the true field capacity of individual unit processes, and to identify phosphorus off-setting opportunities. The study will include the following key tasks:

- ✚ Refine requirements for an optimization
 - Update the design basis (e.g., flow quantity and its variation (average, maximum and peak))
 - Conduct detailed unit process capacity assessments
 - Identify opportunities for unit process optimization

- Develop options to address plant bottlenecks
- + Update process model (e.g. BioWin) to determine the capacity and performance of existing treatment facilities
- + Perform plant hydraulic analysis to evaluate process hydraulic bottlenecks
- + Field testing to demonstrate/confirm true capacities
- + Investigate and confirm feasible phosphorus off-setting opportunities, costs and program requirements
- + Liaison with MOECC to discuss the rationale, approach and findings from the study.

As noted previously, the results of the optimization study for Wellesley WWTP will be used to confirm the timing for an expansion of the plant. If peak flow rates are reduced, there may be an opportunity to defer an expansion.

Estimated cost for optimization and phosphorus off-setting study: \$200,000

Class EA and Conceptual Design for Expansion with Phosphorus Off-setting (2030-2031)

If phosphorus off-setting for the Wellesley WWTP is considered feasible based on the outcome of the phosphorus off-setting study, a Schedule C Class EA will be required to provide additional treatment capacity for secondary treatment.

The Class EA study would include the following key tasks:

- + Identification of problem or opportunity
- + Develop and evaluate alternative design concepts (including investigation of available new technologies)
- + Public, Agency, Indigenous and other stakeholder consultation
- + Although the Wellesley WWTP is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + Pilot testing of preferred technology, if required by the MOECC
- + Prepare ESR
- + Conceptual Design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$200,000

Expansion with Phosphorus Off-Setting (2032-2035)

Key components of the Wellesley WWTP expansion with phosphorus off-setting instead of an expansion to tertiary treatment include:

- + Detailed design (2032-2033)
- + Construction (2034-2035)
 - Add additional raw influent pump capacity
 - Convert the existing aeration tanks to granular sludge system, if confirmed through the Class EA to be the preferred technology
 - Infrastructure for phosphorus off-setting program (e.g., manure storage facilities, milkhouse wastewater treatment and livestock fencing around local creeks)

Estimated cost for expansion: \$6,070,000

8.2.7 Spring Valley SPS

For the Spring Valley SPS, the preferred alternative to accommodate future growth is:

- + Expansion of the station from the existing firm capacity of 245 L/s to a minimum flow of 265 L/s, to be coordinated with asset renewal timelines for the station (expected to be within the next 10 to 15 years). Based on the condition of the existing pumping station, options for asset renewal should include consideration of a new station.

The following sections discuss the projects resulting from the above recommendations.

Short-term Improvements (2018-2019)

Key components of the short-term improvements to the Spring Valley SPS are expected to include:

- + Replacement of the existing pumps to ensure continued reliable operation of the station

Estimated cost for short-term improvements: \$400,000

Class EA and Conceptual Design (2019-2020)

A Schedule B Class EA will be required for the upgrades to the Spring Valley SPS. The Class EA study would include the following key tasks:

- + Identification of problem or opportunity, including confirmation of the future capacity of the Spring Valley SPS.
- + Develop and evaluate alternative design concepts.
- + Public, Agency, Indigenous and other stakeholder consultation.
- + Although the Spring Valley SPS is an extensively disturbed site and therefore no impact is expected, a review for any archaeological or cultural heritage potential is recommended.
- + A project file report preparation
- + Conceptual design of the recommended upgrades

Estimated cost for Class EA and Conceptual Design: \$500,000

SPS Upgrades (2021-2024)

Key components of the Spring Valley SPS upgrades are expected to include:

- + Detailed design (2021-2022)
- + Construction (2023-2024)
 - Pumping station upgrades or construction of new station, depending on outcome of Class EA process

Estimated cost for SPS upgrades: \$13,500,000

8.2.8 Baden and Morningside SPS

For the Baden SPS, as mentioned in Section 6.3.7, there are opportunities to reduce peak flows through I/I reduction. For the Morningside SPS, pump replacement is an option to provide a firm capacity of 290 L/s to accommodate the projected 2051 flow of 272 L/s. However, as the Baden SPS pumps directly to the Morningside SPS (which subsequently pumps flow to the New Hamburg WWTP), the options for these pumping stations are very interrelated. A more detailed study to look at alternatives

for these stations is recommended to determine the best overall strategy to address capacity and operational constraints.

Optimization Study (2019-2020)

Key components of the optimization and study include:

- + Confirm future flow rates for the Baden and Morningside SPS service areas
- + Investigate opportunities to optimize the pumping rate for the Baden SPS based on downstream infrastructure (Morningside SPS and New Hamburg WWTP)
- + Determine preferred approaches for the Baden and Morningside SPSs, which may include expansion, pump replacement and/or I/I reduction

Estimated cost for optimization study: \$200,000.

8.3 Enhance Operations and Reduce Energy Use

8.3.1 Automation Upgrades

Automation upgrades to reduce chemical and energy include the following recommended alternatives:

- + Install ammonia and phosphate analyzers for the three largest WWTPs within the Region (Kitchener, Waterloo and Galt WWTP)
- + Complete cost-benefit analysis using actual results from the larger plants to determine an implementation strategy for automation upgrades at the Region's smaller facilities.

The following sections discuss the resulting projects from the above recommendations.

Automation Upgrades (2019-2024)

Phased implement of automation upgrades at Kitchener, Waterloo and Galt WWTP is recommended as follows:

- + Implement full-scale trial of ammonia and phosphate analyzers at the Kitchener WWTP (2019-2020), including:
 - Installation of ammonia probes/analyzers at the aeration effluent.
 - Installation of phosphate probe analyzers.

- Upgrades to the existing blower control systems to include ammonia feedback control.
 - Upgrades to chemical dosing control system to include phosphate feedback control.
 - Perform detailed cost-benefit assessment for automation upgrades.
- + Implement full-scale trial of ammonia and phosphate analyzers at Waterloo WWTP (2021-2022)
 - + Implement full-scale trial of ammonia and phosphate analyzers at Galt WWTP (2023-2024)
 - + Perform technical feasibility and life-cycle cost analysis for automation upgrades at the Region's remaining WWTPs.

Estimated cost for automation upgrades:

- + \$500,000 for the Kitchener WWTP
- + \$400,000 for the Waterloo WWTP
- + \$400,000 for the Galt WWTP

8.3.2 Energy Neutral Opportunities

As part of the completion of WWTP upgrades and expansions, opportunities to reduce energy use should be considered. Although energy neutrality is not currently within the Master Plan's mandate, energy reduction strategies provide a foundation for potentially becoming energy neutral in the future. A separate study is recommended to develop the framework for becoming energy neutral to allow strategic investments in wastewater infrastructure at the time of asset renewal or upgrades that work towards this vision in a way that is financially sustainable.

While the energy neutrality study should review all of the Region's WWTPs, a specific focus should be placed on the Kitchener, Waterloo and Galt WWTPs as they are the largest plants in the Region with the greatest energy needs, are equipped with anaerobic digestion, and combined heat and power systems are soon to be installed at these facilities (currently under design).

Another component of the energy neutrality study should include a review of co-digestion opportunities, whereby additional substrates are imported into the anaerobic digestion process to increase the biogas production. The goal is to maximize the use of available excess anaerobic digestion capacity where available in the existing plants.

Energy Neutral Opportunities Study (2020-2021)

Key components of this study should include:

- + Baseline assessment of unit process energy use.
- + Identify a long-list of opportunities for unit process energy reduction.
- + Short-list opportunities for a more detailed evaluation. The approach to short-list technologies should include those offering the greatest potential for energy reduction based on compatibility with existing infrastructure, demonstrated full-scale installations, capital, operating and life cycle costs.
- + Evaluate co-digestion opportunities for facilities that have available digestion capacity (e.g. Kitchener and Waterloo WWTPs), including:
 - Market assessment on availability, characteristics and costs of high strength organic waste for co-digestion.
 - Assess infrastructure upgrade requirements at each WWTP to accept hauled wastes for co-digestion
 - Estimate quantities and impacts on WWTP in terms of gas production, digester capacity, recycle stream loadings, truck traffic, etc.
 - Evaluate biogas reuse opportunities including renewable natural gas
- + Conceptual design of recommended upgrades

Estimated cost for energy neutral opportunities study: \$800,000

8.3.3 Anoxic Selector and DO Control

The application of an anoxic selector in a nitrifying plant will provide a pre-denitrification stage, which can partially offset the aeration energy associated with nitrification and reduce the total nitrogen concentration in the effluent. Anoxic

selectors have been installed in several plants in the Region, including the Kitchener and Waterloo WWTPs.

Anoxic selectors are recommended for plants where they are not currently installed including Galt, Hespeler, St Jacobs and Wellesley WWTPs. The installation should be integrated with any planned diffuser replacement project (i.e. asset management) or with planned expansion.

The St Jacobs WWTP is an oxidation ditch and an anoxic selector is best implemented through the installation of jet aeration equipment or similar; which can provide mixing independent of aeration.

To provide improved nitrification during the winter months, especially for those facilities with lower sludge age (i.e. Galt and Hespeler), it is recommended that an anoxic selector be configured with diffusers to allow aerobic operation (i.e. create an anoxic/aerobic swing zone) to improve nitrification during the coldest winter months.

8.3.4 Digester Upgrades

The recommended alternatives to enhance biogas production, reduce sidestream loadings and reduce sludge production in anaerobic digesters includes:

- + Install post-aerobic digester (PAD) for sidestream treatment at the Kitchener WWTP
- + Install thermal hydrolysis process (THP) at the Kitchener WWTP

It is important to note that these alternatives are only recommended if alternative funding becomes available. The following section discusses the resulting project from the above recommendations.

Gas Production Enhancement Opportunities Study (2021-2022)

Key components of this study should include:

- + Compare PAD/THP technologies.
- + Evaluate energy use, chemical use, and biosolids production for PAD/THP.
- + Evaluate the impact of PAD/THP on liquid train process control and final effluent quality.

- + Assess capital, annual, and life cycle costs for full-scale implementation of PAD/THP.
- + Assess biogas re-use options including combined heat and power and renewable natural gas.
- + Complete conceptual design of recommended upgrades
- + Review funding opportunities.

Estimated cost for gas production enhancement opportunities study: \$500,000

8.4 East Side Lands

The East Side Lands describes the developable area on the east side of the Grand River, surrounding the Waterloo Regional Airport. The area encompasses approximately 4,000 hectares of land in the Township of Woolwich, the City of Cambridge, and the City of Kitchener. It is anticipated to be predominately a mixture of ICI with some residential land use.

Several planning studies have provided input on sanitary servicing for the ESLs including the 2007 WWTMP (Earth Tech, 2007) and the recent ESL Sanitary Servicing Class EA (Associated Engineering, ongoing). The following are recommendations from these studies to service the ESLs:

- + 2007 WWTMP
 - Transfer IRSA flows from the Preston WWTP to the Galt WWTP to release capacity at the Preston WWTP
 - Service the south area of the ESL in the short-term using the available capacity at the Preston WWTP
 - Service the entire ESL long-term using the Kitchener WWTP, which is a larger plant and has more available capacity to service the ESL
- + ESL Sanitary Servicing Class EA
 - Construct a gravity trunk sewer with a dedicated service bridge over the Grand River to divert flows from the southern area of the ESL to the Kitchener WWTP

As part of the 2018 WWTMP Update, further investigation was completed to confirm the short-term servicing strategy of conveying flows to the Preston WWTP. Specifically, a review was completed to review potential constraints in the collection system and estimate when the long-term servicing solution to convey flows to the Kitchener WWTP needs to be constructed.

Overall, the Preston WWTP has sufficient average day rated capacity to manage projected population growth together with the ESL growth until approximately 2041 based on the planning projections developed through the 2018 WWTMP Update. A review of the collection system indicates that the capacity would be reached at the Preston WWTP before constraints would occur in the sanitary trunk sewers. It is recommended that both the plant flows and collection system flows be monitored to capture deviations from the planning projections to ensure that timing remains as expected for the diversion to the Kitchener WWTP (refer to TM8 – Capacity Assessment of Fountain Street Trunk Sewer, available in Appendix I, for additional details).

A diversion to the Kitchener WWTP must be constructed and commissioned ahead of this 2041 timeline to ensure the Preston WWTP continues to operate within the approved rated capacity. As noted above, the ESL Sanitary Servicing Class EA recommended a new gravity trunk sewer to direct flows from the southern area of the ESL to the Kitchener WWTP. After this long-term servicing solution has been constructed, the available capacity at the Preston WWTP and associated collection system will be restored.

Class EA Study and Conceptual Design (2030-2032)

Class EA studies remain valid for a period of ten years. Based on the anticipated timing to construct the long-term servicing solution in the 2034-2035 timeframe, an update to the current Class EA will need to be completed to confirm the servicing approach as this exceeds the Class EA validity period.

Estimated Cost for Class EA and Conceptual Design Update: \$400,000

Diversion to Kitchener WWTP (2032-2035)

Key components of the diversion project to the Kitchener WWTP include:

- ✦ Detailed design (2032-2033)

✚ Construction (2034-2035)

- A gravity trunk with a dedicated service bridge over the Grand River to divert flows from the southern area of the ESL to the Kitchener WWTP

Estimated cost for diversion to Kitchener WWTP: \$34,000,000

9. Implementation Schedule and Costs

Table 45 summarizes the projects, timing and costs for the WWTMP program, sorted by date. Table 46 summarizes the schedule for the projects recommended for the WWTMP program, sorted by facility.

Table 45 Summary of Recommended Infrastructure Option Projects (By Date)

Year	Project	Cost (2018 \$)
Short-Term (2018 to 2025)		
2018/19	Spring Valley SPS Short-term Improvements Construction	\$400,000
2018/20	Waterloo & St Jacobs WWTP Optimization Study	\$900,000
2018/20	Hespeler WWTP Short-term Upgrades - Engineering	\$1,650,000
2018/20	Hespeler WWTP Short-term Upgrades - Construction	\$14,000,000
2019	St Jacobs WWTP Short-term Improvements - Conceptual Design	\$100,000
2019/20	I/I Reduction Study for Wellesley WWTP	\$300,000
2019/20	I/I Reduction Study for Ayr WWTP	\$300,000
2019/20	Preston WWTP Process Optimization Study	\$200,000
2019/20	Kitchener WWTP Automation Upgrades	\$500,000
2019/20	Baden & Morningside SPS Optimization Study	\$200,000
2019/20	Spring Valley SPS Upgrades - Class EA and Conceptual Design	\$500,000
2019 to 2028	I/I Reduction and Water Re-Use Program	\$100,000 per year
2020	Hespeler WWTP Nitrification Upgrades - Conceptual Design	\$100,000
2020	Elmira WWTP Optimization Study	\$300,000
2020/21	St Jacobs WWTP Short-term Improvements - Engineering	\$500,000
2020/21	Energy Neutral Opportunities Study	\$800,000
2020/22	Hespeler WWTP Nitrification Upgrades - Engineering	\$1,000,000
2021/22	Elmira WWTP Short-term Improvements - Engineering	\$500,000
2021	Preston WWTP Process Optimization	\$200,000
2021	St Jacobs WWTP Short-term Improvements - Construction	\$2,500,000
2021/22	Waterloo WWTP Automation Upgrades	\$400,000
2021/22	Kitchener WWTP Gas Production Enhancement Study	\$500,000
2021/22	Hespeler WWTP Nitrification Upgrades - Construction	\$6,000,000
2021/24	Spring Valley SPS Upgrades - Engineering	\$1,500,000
2021/23	Waterloo WWTP Expansion - Class EA and Conceptual Design	\$1,500,000
2022	Elmira WWTP Short-term Improvements - Construction	\$2,500,000
2023/24	Galt WWTP Automation Upgrades	\$400,000
2023/24	Spring Valley SPS Upgrades - Construction	\$12,000,000
2023/25	St Jacobs WWTP Expansion - Class EA and Conceptual Design	\$300,000
2023/28	Waterloo WWTP Expansion - Engineering	\$6,000,000
2024/25	Elmira WWTP Expansion - Class EA and Conceptual Design	\$400,000

Year	Project	Cost (2018 \$)
Mid-Term (2026 to 2033)		
2025/29	St Jacobs WWTP Expansion - Engineering	\$1,200,000
2026/28	Waterloo WWTP Expansion - Construction	\$54,000,000
2026/30	Elmira WWTP Expansion - Engineering	\$2,000,000
2028/29	St Jacobs WWTP Expansion - Construction	\$10,800,000
2028/29	Wellesley WWTP Optimization and Phosphorus Off-setting Study	\$200,000
2028/30	Elmira WWTP Expansion - Construction	\$15,000,000
2030/31	Wellesley WWTP Expansion - Class EA and Conceptual Design	\$300,000
2030/31	East Side Lands - Class EA Update and Conceptual Design	\$400,000
2032/35	Wellesley WWTP Expansion - Engineering	\$1,000,000
2032/35	East Side Lands Kitchener Diversion - Engineering	\$4,000,000
Long-term (Beyond 2033)		
2034/35	Wellesley WWTP Expansion - Construction	\$7,000,000
2034/35	East Side Lands Kitchener Diversion - Construction	\$30,000,000
2036/38	Hespeler WWTP Expansion - Class EA and Conceptual Design	\$700,000
2039/43	Hespeler WWTP Expansion - Engineering	\$1,900,000
2041/43	Hespeler WWTP Expansion - Construction	\$13,600,000

Table 46 Summary of Recommended Infrastructure Option Projects (By Facility)

[illegible]

[illegible]

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